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Madison County, New York

Investment Grade Audit

nationalgrid

THE POWER OF ACTION

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SMARTWATT Energy Inc.®

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1.0 Executive Summary

1.1 Project Overview

SmartWatt Energy, Inc. (SmartWatt) is pleased to provide this Investment Grade Audit for Madison County, NY. We developed the following report to identify, document, and present a full complement of infrastructure improvements and cost reduction strategies for Madison County. SmartWatt is providing this report to fulfill the requirements of Project ID SMEI.002 under the Master Services Agreement between National Grid and SmartWatt Energy.

We greatly value the support we have received from Madison County staff during the IGA and look forward to expanding our partnership with National Grid and the County by implementing the Facility Improvement Measures described in the report through a Utility Energy Services Contract (UESC).

This report provides the scope of work, energy savings estimates, and cost proposal for infrastructure improvement and cost reduction strategies at eight buildings in the County:

- County Office Building
- Veterans Building
- Facilities Maintenance Garage
- Courthouse
- DSS
- Public Health
- Jail
- Wampsville Highway Department

SmartWatt will complete the scope of work described in this proposal for an installed cost of **$2,740,518.** SmartWatt will procure incentives from National Grid with an estimated value of **$172,777.** If the value of the incentives exceeds the estimated value of $172,777, the full incentive value will be provided to the County at the completion of the project implementation. Thus, the overall project cost to the County after incentives is **$2,567,740.**

1.2 Summary of Proposed Facility Improvement Measures (FIMs)

SmartWatt previously conducted a Preliminary Feasibility Assessment (PFA) to document the potential energy savings and budgetary costs. The Facility Improvement Measures (FIMs) identified in the PFA were evaluated in detail and the FIMs shown in Table 1 were selected by the County for implementation.

The 9 FIMs identified in this report will result in a total annual energy cost savings of $101,323/yr, which translates to a 23% reduction in annual utility costs. In addition, annual replacement savings of $12,325 are identified associated with the long life of LED lighting as compared to the existing lamps and ballasts. Annual repair and replacement savings of $91,995 have also been identified. Our project maximizes the financial benefit of the UESC by combining longer payback capital improvement items with shorter

payback measures—in turn giving Madison County the flexibility to tailor the selection to achieve shorter paybacks, greater energy independence, or other objectives as the County sees fit.

Table 1 provides savings, implementation price, and National Grid incentive for the recommended FIMs. The FIM recommendations presented will provide Madison County the ability to accomplish the following:

- Reduce annual electricity consumption by 26%
- Decrease annual natural gas consumption by 18%
- Decrease the energy intensity from 91 kBtu/ft^2 to 72 kBtu/ft^2

Table 1 - Summary: Recommended Facility Improvement Measures (FIMs)

FIM Name	Annual Utility Savings ($/yr)	Annual Repair & Replacement Savings ($/yr)	FIM Cost	National Grid Incentive	Net Customer Cost (minus Incentives)
1 - Lighting Upgrades	$48,495	$12,325	$503,946	$72,162	$431,784
2 - Replace Water Source Heat Pumps	$21,103	$60,000	$1,504,219	$32,893	$1,471,326
3 - Building Envelope Improvements	$7,819	$0	$108,743	$14,851	$93,892
4 - EMS Upgrades	$8,882	$0	$127,611	$21,885	$105,726
5 - Install ECM Motors	$549	$0	$1,880	$940	$940
6 - Replace Boilers in Jail	$2,325	$20,628	$206,280	$6,000	$200,280
7 - Install DHW Heaters in Jail	$1,140	$11,327	$113,273	$2,400	$110,873
8 - Window Tinting at County Office Bldg	$8,628	$0	$125,894	$18,332	$107,562
9 - Replace Transformers	$2,381	$0	$48,673	$3,316	$45,358
TOTAL	**$101,323**	**$104,280**	**$2,740,518**	**$172,777**	**$2,567,740**

1.3 Project Guidelines and Goals

SmartWatt has worked with the following objectives in mind for the Madison County Facilities:

- Reduce energy costs for the County's facilities.
- Maintain or improve existing environment within each facility.
- Provide and improve operational control of the County's equipment and systems.

Additional benefits to the County will include:

- No requirement for a referendum and voter approval.
- This project will not affect the Counties debt limit, or ability to bond future capital projects.
- Work performed under a normal, properly planned and executed schedule and not under an emergency situation.
- Guarantees quality engineering, construction and long-term performance under a turnkey approach.
- Portion of project will be offset by incentives from National Grid totaling **$172,777.**

1.4 Utility Incentives Summary

During this study, we confirmed that several of the facility improvement measures (FIMs) listed in this IGA, are eligible for incentives through National Grid. SmartWatt will work directly with National Grid to provide the incentives indicated in Table 1. SmartWatt will fill out the required forms and provide for

the County's review and signature. The incentives will be paid to SmartWatt and provided to the funding source to reduce the total amount financed by $172,777. Any additional incentives received will be provided to the County by SmartWatt.

1.5 Environmental Benefits

In addition to reducing energy consumption, these turnkey improvements give Madison County the opportunity to reduce its carbon footprint, reducing harmful environmental impacts. The positive impact this project will have on the environment is quantifiable. Most of the energy generated by power plants in the United States comes from burning fossil fuels. By reducing your energy consumption, fewer fossil fuels are consumed which means less pollution. For the Madison County area, the project will reduce green house gases by about:

- 752 metric tons CO_{2e} each year

Figure 1 illustrates the reduction in green house gases each year in terms of equivalencies of familiar items.

Figure 1 - Green House Reduction Equivalencies

152 Vehicles Off the Road **617 Acres of Carbon Sequestered by Trees** **Energy for 69 Homes**

1.6 Other Measures Considered But Not Recommended

A few FIMs identified during the PFA were evaluated during the IGA that did not meet the goals of the County. These items were presented during a scope review session and removed from consideration for the reasons described in Table 2.

Table 2 – FIMs Investigated but Not Recommended

Potential FIM	Description	Reason Not Recommended
Lighting Upgrades (Courthouse and Morrisville Highway Department)	Upgrade lighting to LED.	Facility future use uncertain.
Building Envelope Upgrades at Morrisville Highway Department	Replace seals on human and garage bay doors.	Facility future use uncertain.
Building Envelope Upgrades at Landfill Bldg #2	An evaluation of infiltration and thermal improvements was conducted for this building.	The building primarily uses waste oil for space heating which is free to the County. The small volume of propane used resulted in a payback of over 100 years. Thus, the measure was excluded due to poor economic return on investment.
Water Conservation	A detailed water assessment was performed that included all County buildings in the project scope. Improvements evaluated included sinks, toilets, urinals, and cell flush valves at the Jail.	The County pays a very low rate for water and has minimal sewer charges for its largest water consuming facility (the Jail which utilizes a septic tank). The payback of 62 years greatly exceeds the expected equipment life. The existing units were determined to be operational for several years and not in need of immediate replacement.
Transformers at the Courthouse	High efficiency transformers were evaluated at several buildings including the Courthouse.	Facility future use uncertain.
Replace Skylights at County Office Building	Replace 64 skylights above the atrium with a Kalwall structure to reduce energy losses and prevent water damage from failing skylights.	County has opted not to include at this time. Will consider options and may look to implement at a later date.

2.0 Facility Description

2.1 Facility Locations

Madison County is located in the Mohawk Valley region of New York State. SmartWatt Energy Engineers audited ten building locations in Madison County as summarized in Table 3. The total square footage of the sites audited is about 299,961 ft^2.

Table 3 - Facility Summary

Facility	Address	Square Footage
County Office Building	138 N Court Street, Wampsville, NY	54,180
Veterans Building	138 N Court Street, Wampsville, NY	24,200
Facilities Maintenance Garage	138 N Court Street, Wampsville, NY	5,000
DSS	133 N Court Street, Wampsville, NY	47,882
Courthouse	138 N Court Street, Wampsville, NY	34,020
Public Health	138 N Court Street, Wampsville, NY	15,244
Jail	138 N Court Street, Wampsville, NY	55,440
Hwy Department (Wampsville)	5 Donald Hicks Dew Drive, Wampsville, NY	38,798
Hwy Department (Morrisville)	85 Cedar Street, Morrisville, NY	18,797
Landfill Bldg 2	6663 Buyea Rd, Canastota, NY	6,400

Although the Morrisville Highway Department and Landfill Building #2 were assessed no Facility Improvement Measures are recommended for these two sites and they are excluded from the remainder of the report.

County Office Building

The County Office Building (COB) is a two story building with a basement floor that was built in 1969. The building is typically occupied from 8:00 AM to 6:00 PM.

This building has three boilers (Patterson-Kelley Mach 150 condensing units) and two chillers (Trane Series R 170 tons) that generate hot and cold water that serves the air handling units in the County Office Building, Courthouse, and Public Health. There are five fan coil units (FC 1-5) that provide heating and cooling throughout the facility. Each of the fan coils has a 7.5 HP supply fan.

This building shares utility meters with the Courthouse and Public Health building for electricity, natural gas, and water.

Annual utility spend for all three buildings is approximately $181,629.

The building is equipped with a pneumatic / digital Johnson Controls Energy Management System (EMS). This system provides controls for the majority of the heating and cooling equipment. The EMS can be accessed from a graphical user interface in the Maintenance Supervisors' office.

Veterans Building

The Veterans Building is a two story office building built in 1994. The hours of operation are Monday; 7:30 AM-6:00 PM, Tuesday; 7:30 AM – 8:00 PM, Wednesday; 7:30 AM – 5:00 PM, Thursday; 7:30 AM-5:00 PM, and Friday 7:30 AM-5:00 PM.

The Veterans Building has two condensing 750 MBH Patterson-Kelley Mach series boilers. One of the boilers serves the water source heat pump loop, while the other boiler serves perimeter fin tube radiation. The heat pump loop is served by a cooling tower located on the roof. The building has a total of 22 water source heat pumps ranging in size from 1.5 to 3.5 tons each. There is a dedicated make up air unit used to supply outside air to the heat pumps that are located throughout the facility. The building is equipped with a pneumatic / digital Johnson Controls Building Management System.

Utilities are electric, natural gas, and water. Annual utility spend is approximately $35,828.

Maintenance Garage

The Maintenance Garage is located adjacent to the Jail. The building consists of garage bays for trucks, file storage rooms, and a break room. The operational hours are 7:30 AM to 4:00 PM, Monday through Friday.

The Maintenance Garage is heated with infrared heaters in the truck bays, along with electric baseboard and gas fired unit heaters in the break room.

Utilities are electric, natural gas, and water, with an average utility spend of about $4,242.

Department of Social Services

The Department of Social Services (DSS) is a two-story office building located across the street from the County Complex. The hours of operation are Monday through Friday 7:30 AM - 5:00 PM, with a cleaning crew in the facility until approximately 8:30pm.

The DSS has fifty one (51) water source heat pumps located throughout the facility that are being served by two Patterson-Kelley Mach 750 condensing boilers located in the basement. The loop is also served by a cooling tower located on the roof. Two 10 ton heat pumps (HP-1 and HP-2) in the basement supply outside air to the majority of the smaller heat pumps located throughout the facility. The building has a Johnson Controls EMS. This system provides control for all the WSHPs located throughout the building with a graphical user interface located in the Maintenance Supervisor's office.

Utilities are electric, natural gas, and water. Annual utility spend is approximately $74,236.

Courthouse

The County Courthouse is located adjacent to the County Office Building. The typical hours of operation are 8:00 AM – 6 PM Monday through Friday.

The Courthouse is being served by the boilers and chillers located in the County Office Building. The building is conditioned with 2 Fan Coil Units (FCU 101 and FCU 102, each with 3 HP supply fans) and 2 Air Handling Units (AHU-1 and AHU-2, each with 5 HP supply fans).

This building shares utility meters (electric, natural gas, and water) with the County Office Building and Public Health building. Annual utility spend for all three buildings is approximately $181,629.

The building is controlled by a central EMS system located in the Maintenance Supervisor's Office.

Public Health

The Public Health Building is occupied from 8:00 AM to 5 PM, Monday - Friday. It is located next to the County Office Building. The building consists primarily of office space.

There is one multizone air handling unit with twelve zones, located in the basement. The unit has heating and cooling coils that are being served from the central plant located in the County Office Building. The air handling unit has a 15 HP supply fan.

This building shares a utility meter with the Courthouse and County Office Building. Annual utility spend for all three buildings is approximately $181,629.

The building is also controlled with the Johnson Controls EMS.

Jail/PSB

The County Jail is located northeast of the Maintenance Garage. The building operates 24 hours/ day. The facility is divided into Public Service space which is primarily office space for the County Sherriff department and the Jail which typically houses about 60 inmates.

The building is conditioned by 39 water source heat pumps which range in size between ¾ - 5.4 tons. The heat-pumps are supplied by three boilers (2 Precision Model G300 boilers and one Patterson-Kelley Thermific boiler with an output of 1,020 MBH) and a cooling tower. There is an isolation chamber located towards the center of the building. This area is under negative pressure and the unit has its own dedicated exhaust and supply air for the purposes of containing infectious diseases. The building's HVAC equipment is controlled via the Johnson Controls EMS.

The building has its own electric, gas, and water meters. Annual utility spend is approximately $111,169.

Wampsville Highway Department

The Wampsville Highway Department facility reviewed in this project consists of a two story office building and the maintenance garage as shown in the picture to the right. The facility is typically occupied between 7 AM and 5 PM on weekdays with additional use as required for winter plowing.

The garage area is heated with infrared heaters and is not cooled. The total annual utility spend for these two buildings is about $41,860.

3.0 Utility Usage Overview

3.1 Utility Usage and Cost Summary

The County currently spends **$448,784** annually on utilities for the following eight buildings included in the recommended Scope of Work:

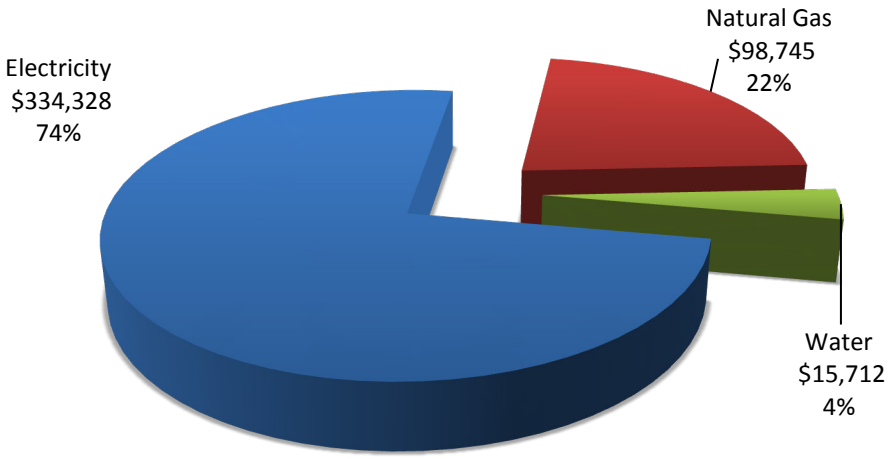
- County Office Building
- Veterans Building
- Facilities Maintenance Garage
- Courthouse
- DSS
- Public Health
- Jail
- Wampsville Highway Department

Table 4 and Figure 2 summarize the energy cost allocated to natural gas, electric, and water/sewer consumption for the eight total buildings assessed in our investigation for the baseline period (January 2014 – December 2014). Figure 2 indicates that electricity accounts for the vast majority (74%) of the County's utility costs.

Table 4 –Annual Utility Usage and Cost Summary

Electricity		Natural Gas		Water & Sewer	
kWh/yr	$/yr	NG (therm/yr)	$/yr	Water (CCF/yr)	$/yr
3,569,710	$ 334,328	127,033	$ 98,745	5,634	$ 15,712

Figure 2 - Annual Utility Costs



3.2 Utility Rate Review

Utilities and energy sources for the buildings reviewed in the County are electricity, natural gas, and water/sewer. Table 5 lists the utilities and energy sources and the current supplier of each source.

Table 5 - Utility/Energy Sources

Utility/Energy Type	Company
Electricity Supply	Constellation Energy
Electricity Transmission/Distribution	National Grid
Natural Gas Supply	Direct Energy
Natural Gas Distribution	National Grid
Water/Sewer	City of Oneida

To determine the cost savings potential for a reduction in energy usage or water conservation the incremental cost of the utility was determined. Electricity and natural gas distribution costs (National Grid) are based on the average for billing during the 2014 baseline period. Electricity and natural gas supply costs are based on the current contract with the supply company in use. Water rates are based on the baseline period billing data provided by the County. The rates used to calculate savings are summarized in Table 6.

Table 6 -Utility Rates Summary

Building	Electricity Distribution ($/kWh)	Electricity Supply ($/kWh)	Electricity Total ($/kWh)
County Office Building	$0.032	$0.058	$0.090
Veterans Building	$0.039	$0.058	$0.096
Facilities Maintenance Garage	$0.032	$0.058	$0.090
DSS	$0.032	$0.058	$0.090
Courthouse	$0.032	$0.058	$0.090
Public Health	$0.032	$0.058	$0.090
Jail	$0.031	$0.058	$0.089
Hwy Department (Wampsville)	$0.082	$0.058	$0.140

Building	NG Distribution ($/therm)	NG Supply ($/therm)	NG Total ($/therm)	Water & Sewer ($/CCF)
County Office Building	$0.177	$0.574	$0.751	$2.92
Veterans Building	$0.243	$0.574	$0.817	$3.47
Facilities Maintenance Garage	$0.395	$0.574	$0.969	$5.51
DSS	$0.284	$0.574	$0.858	$3.39
Courthouse	$0.177	$0.574	$0.751	$2.92
Public Health	$0.177	$0.574	$0.751	$2.92
Jail	$0.209	$0.574	$0.783	$2.52
Hwy Department (Wampsville)	$0.395	$0.574	$0.810	$2.92

3.3 Baseline Annual Energy Usage

This section summarizes the baseline period energy usage for the seven buildings audited. Table 7 presents a summary of the average utility consumption for each building by energy source for the baseline year (2014). A summary of the baseline period usage and cost data are provided in Appendix A.

Table 7 –Baseline Utility Usage Summary

Facility	Electric Usage (kWh/yr)	Natural Gas Usage (therm/yr)	Water Usage (CCF/yr)
County Office Building	1,531,617	48,628	1,526
Veterans Building	270,880	11,080	337
Facilities Maintenance Garage	12,194	2,399	33
DSS	732,000	5,828	538
Courthouse	-	-	-
Public Health	-	-	-
Jail	851,400	32,525	3,200
Hwy Department (Wampsville)	171,619	26,573	
Total	**3,569,710**	**127,033**	**5,634**

Figures 3 to 5 indicate the electricity, natural gas, and water usage percentages for each building. The pie charts show that the three buildings (County Office Building, Courthouse, and Public Health) that share utility meters constitute the majority of the energy usage in the County.

Figure 3 – Electricity Usage by Building

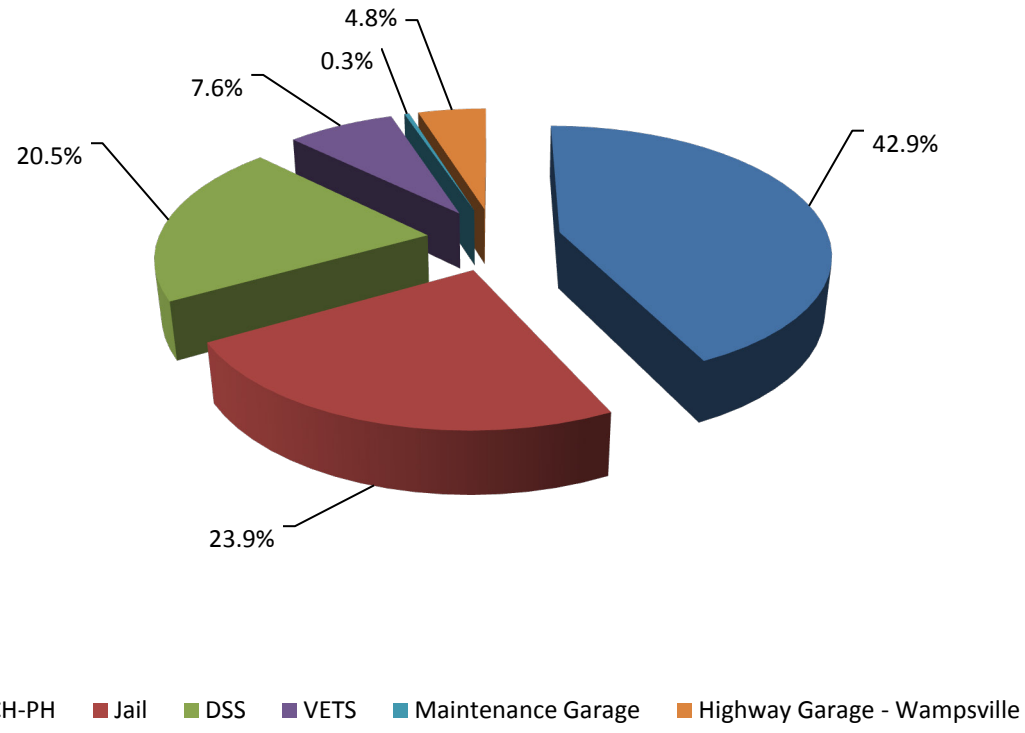


Figure 4 – Natural Gas Usage by Building

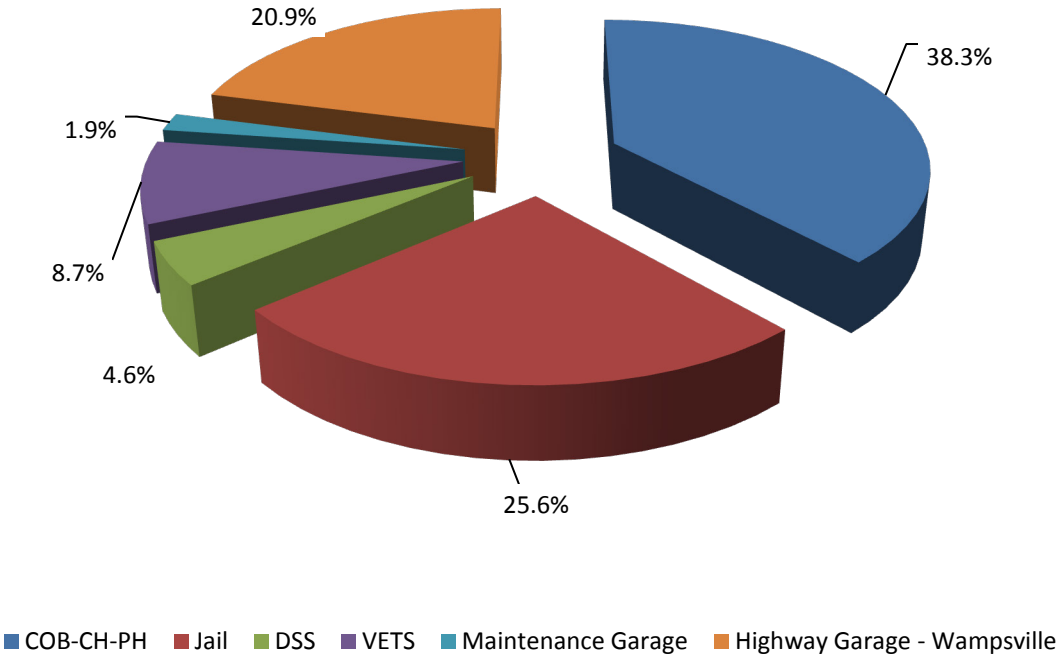
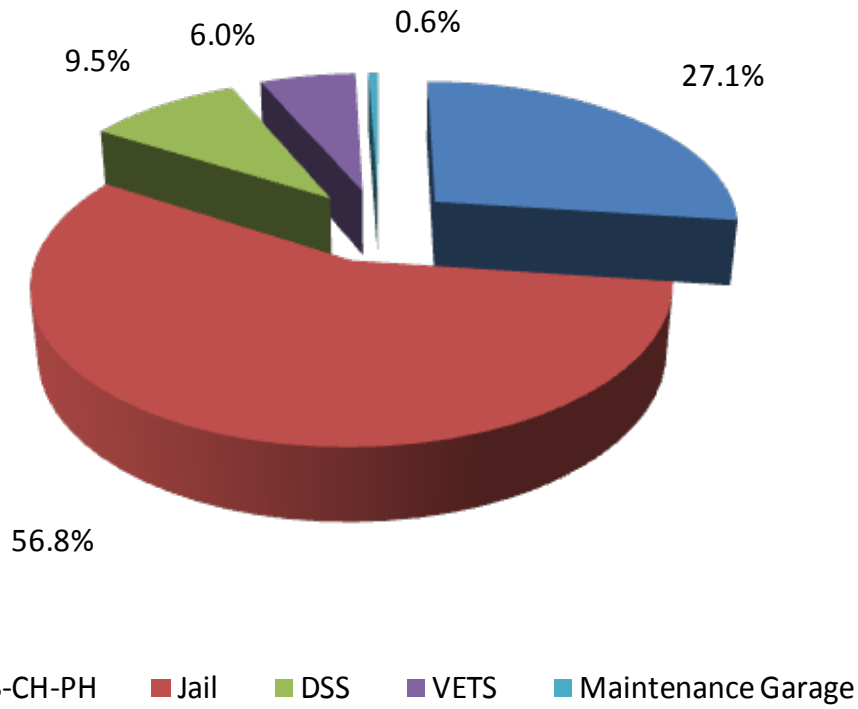


Figure 5 – Water Usage by Building



Figures 6 and 7 display the monthly utility usage for electricity and natural gas during the baseline period (2014). Figure 8 shows quarterly water consumption for the baseline period (2014). Annual usage and cost data for energy and water/sewer is provided in Appendix A in tabular form.

Figure 6 – Baseline Electrical Usage

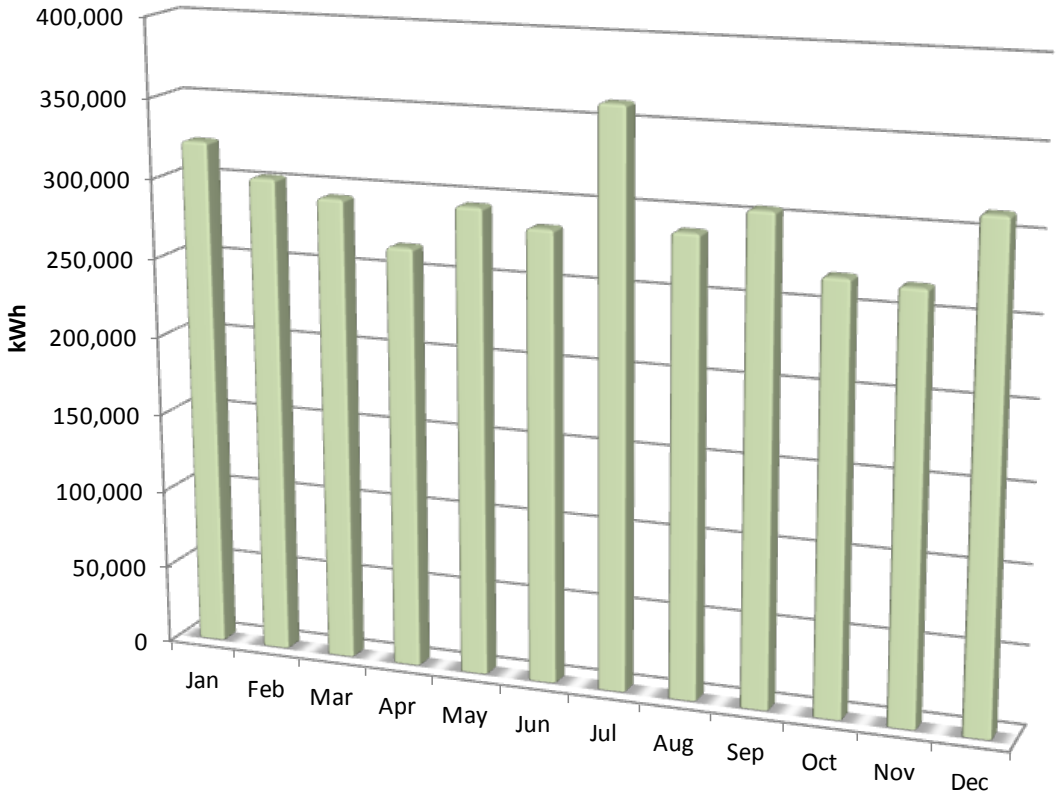


Figure 7 – Baseline Natural Gas Usage

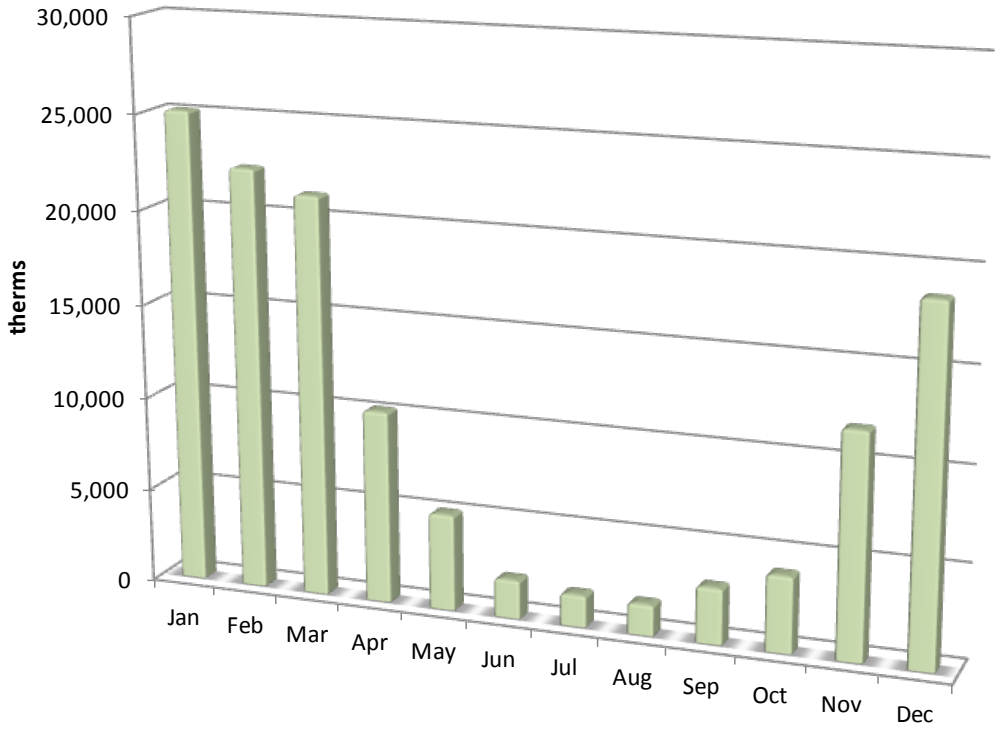
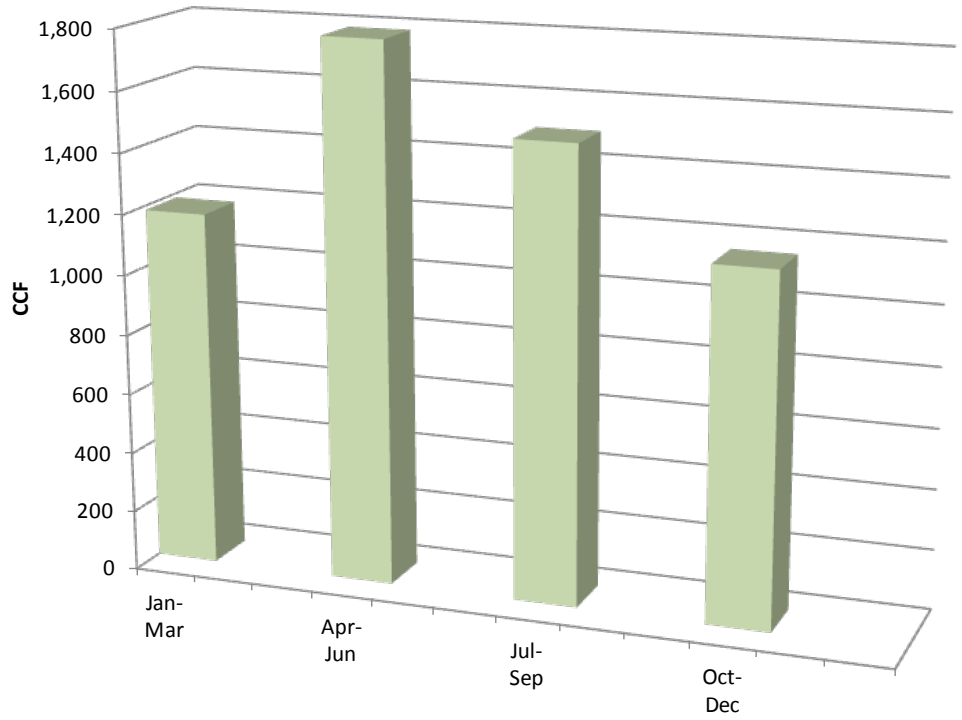


Figure 8 – Baseline Water Usage



3.4 Reconciliation of Usage to Baseline

The data used for the energy/water baseline have been reviewed and no unusual findings were present. The meter readings were based on actual readings during the baseline period (calendar year 2014).

3.5 Utility Benchmarking – Energy Utilization Index

The Energy Utilization Index (EUI) provides a summary of a building's energy intensity. Tracking your EUI over time provides insight into the energy usage behavior of your facility. Table 8 summarizes the annual average energy (electricity and natural gas) usage, cost, and energy intensity for the baseline period.

Table 8 - Average Energy Intensity Summary

Facility	Square Footage	Annual Energy Usage (kBtu/yr)	Annual Energy Cost ($)	EUI (kBtu/ft^2)	Cost per Square Foot ($/ft^2)
COB / Courthouse / Public Health	103,444	10,090,209	$177,166	98	$1.71
Veterans Building	24,200	2,032,513	$34,658	84	$1.43
Maintenance Garage	5,000	281,518	$4,061	56	$0.81
DSS	47,882	3,081,116	$72,413	64	$1.51
Jail	55,440	6,158,328	$103,094	111	$1.86
Highway Garage – Wampsville	42,984	3,243,036	$41,680	75	$0.97

4.0 Facility Improvement Measures (FIMs)

FIM #1: Lighting Upgrades

Annual Cost Savings	Implementation Cost	Incentive/Rebate
$60,820	$503,946	$72,162

Facilities Affected

This FIM will be completed in the following facilities:

- County Office Building
- Veterans Building
- Facilities Maintenance Garage
- DSS
- Public Health
- Jail
- Highway Department (Wampsville)
- Exterior Lighting

A savings summary for the affected buildings is provided in Table 9.

Table 9 – Lighting Savings Summary by Building

Facility Name	Guaranteed Annual Utility Savings ($)	Operational Savings ($)	Total Annual Cost Savings
County Office Building	$9,679	$2,097	$11,775
Veterans Building	$4,046	$1,079	$5,126
Facilities Maintenance Garage	$515	$114	$629
DSS	$6,464	$1,809	$8,273
Public Health	$1,957	$565	$2,523
Jail	$10,494	$3,990	$14,484
Hwy Department (Wampsville)	$4,809	$793	$5,602
Exterior Lighting	$10,530	$1,878	$12,408
TOTAL	$48,495	$12,325	$60,820

Observation

A detailed audit of the existing lighting was conducted at the above facilities including indoor and exterior lighting. While on site, SmartWatt noticed a mix of lighting technologies. The majority of the lighting in the Jail is T8 and CFL lighting. In the Veterans, Facilities Maintenance Garage, Public Health building, and DDS the predominate lighting technology is fluorescent T8 lighting. The highway garage in Wampsville has a combination of T8, T12 and T5 fluorescent technologies. The Office building has a combination of T8 and T12 lighting. Most exterior lighting throughout the County is equipped with high pressure sodium fixtures. A detailed space-by-space audit, which details the existing conditions, is provided in Appendix D.

Recommendation

SmartWatt will replace the existing T5, T12 and T8 lighting with LED lighting technology. In addition, SmartWatt will replace the existing HID exterior lighting with LED lighting. SmartWatt will furnish and install occupancy sensors to automatically shut the lights off in certain identified areas.

The lighting upgrade includes:

- 3,409 interior fixtures retrofitted
- 195 exterior fixtures retrofitted
- 147 occupancy sensors installed

Table 11 provides a summary of the lighting upgrades by fixture type. Detailed summaries of the lighting upgrades and count for each fixture type and space-by-space detail are provided in Appendix D. Cut sheets for the materials described in Table 10 are provided in Appendix C.

Table 10 – Lighting Fixture Upgrades Summary

Fixture Code	Quantity	Fixture Description
Interior Fixtures		
6' hallway uplight retro	7	P-2 LED retrofit kit for 6' indirect hallway custom fixtures
8' hallway uplight retro	28	P-2 LED retrofit kit for 8' indirect hallway custom fixtures
LED exit sign retrofit	25	LED exit sign retrofit-JAIL
LED night light retrofit	63	Retrofit fixture night light with LED retrofit kits
Philips FBX 12L	26	New Philips 12,000 Lumen FBX Highbay
RB/1LED/L	139	Rebuild with (1) 12.5 watt LED tube and low power, instant start ballast
RB/1LED/L-2'	1	Rebuild with (1) 8.5 watt LED tube and low power, instant start ballast
RB/2LED/L	527	Rebuild with (2) 12.5 watt LED tubes and low power, instant start ballast
RB/2LED/L-2'	10	Rebuild with (2) 8.5 watt LED tubes and low power, instant start ballast
RB/3LED/L	1066	Rebuild with (3) 12.5 watt LED tubes and low power, instant start ballast
RB/4LED/L	255	Rebuild with (4) 12.5 watt LED tubes and low power, instant start ballast
RB1LED N-JAIL	68	Rebuild with (1) 12.5 watt LED tube and normal power, instant start ballast-JAIL
RB1LED2 'N 4pin-JAIL	4	Rebuild with (1)Philips 16.5 watt LED T8 4000K 4 pin, instant start -JAIL
RB2LED N-JAIL	310	Rebuild with (2) 12.5 watt LED tubes and normal power, instant start ballast-JAIL
RB2LED2 'N 4pin-JAIL	22	Rebuild with (2)Philips 16.5 watt LED T8 4000K 4 pin, instant start -JAIL
RB2LED2' N-JAIL	70	Rebuild with (2) 8.5 watt LED tubes and normal power, instant start ballast-JAIL

Fixture Code	Quantity	Fixture Description
RB2LED3' N	3	Rebuild with (2) 10.5 watt 3' LED tubes and normal power, instant start ballast
RB2LEDU L	90	Rebuild with (2) 16.5 watt LED U tubes and normal power, instant start ballast-JAIL
RB2LEDU N-JAIL	2	Rebuild with (2) 16.5 watt LED U tubes and normal power, instant start ballast-JAIL
RB4LED N-JAIL	83	Rebuild with (4) 12.5 watt LED tubes and normal power, instant start ballast-JAIL
Retrofit jail Canopy fixture to LED	46	Retrofit canopy fixture LED retrofit kit - 7 watts
RKIH8/2LED/L	1	Retrofit IH8 with (2) 12.5 watt LED tubes and low power, instant start ballast
RKTF/2LED/N	176	Retrofit 2' x 4' troffer with (2) 12.5 watt LED tubes and normal power, instant start ballast
RKTF/LED/LW-Pris	88	P-2 2x4 LED prismatic troffer conversion kit, LW lumens (4445) 4000K
RKTT/LED/LW-Pris	70	P-2 2x2 LED prismatic troffer conversion kit, LW lumens (2356) 4000K
RL A lamp	35	Philips 10 watt A lamp 2700K
RL Par 30 LED 12w	14	Relamp with dimmable par 30 LED lamp
RL/2LED/PLED	3	Relamp with (2) 14.5 Watt LED direct replacement CFL lamps-Horizontal
RL/LED/PLED	177	Relamp with (1) 14.5 Watt LED direct replacement CFL lamps-horizontal
Interior Occupancy Sensors		
MRF2-1S8A-10C	1	Ceiling sensor/wireless switch package
MS-OPS6M2-DV-WH	137	Wall sensor, detects heat from occupants in the room
OSC15-I0W	9	6CC SNSR CLNG 1500
Exterior Fixtures		
139 watt Type III area	13	New Philips Type III area light - 139 watts
LED retrofit	17	Retrofit 8" LED can with 14 watt LED can retrofit kit
ALED26	10	New Rab LED area light - 30 watts
ALED5T26W	33	New Rab LED lantern light - white - 30 watts
FXLED105T	3	New Rab LED flood light - trunnion mount - 107 watts
FXLED300T	6	New Rab LED flood light - trunnion mount - 315 watts
HSLED18A	7	New Rab LED flood light - 20 watts
RKDRUM/LED	37	Retrofit drum fixture with 12w LED conversion kit.
RL A lamp	43	Philips 10 watt A lamp 2700K
RWLED3T78	7	New Rab LED area cobra head Type III - 78 watts
SLIM26	10	New Rab LED wall pack - 29 watts
SLIM26/PC2	6	New Rab LED wall pack - 29 watts - with photo control
SLIM37	3	New Rab LED wall pack - 37 watts

Savings Summary

Savings associated with replacing the lighting systems are associated with the reduction in wattage of the existing fixtures to more efficient units (e.g., LED lighting) and through the use of improved lighting controls. Savings for lighting measures are based on two components:

- Energy savings associated with a reduction in lamp/fixture power and operating hours.
- Reduction in operating costs associated with the increased life of new LED lighting.

Detailed savings calculations are provided in Appendix B. For each building, the lighting energy savings for retrofits that do not include a reduction in operating hours associated with occupancy sensors are based on the following calculation:

$$\text{Energy Savings (kWh/yr)} = (kW_{before} - kW_{after}) * \text{Operating Hours}$$

The existing and retrofit wattages are based on each fixture type. The hours of operation for the lighting fixtures were determined through the deployment of lighting data loggers. The loggers used record the current run hours of lamps as well as the occupancy during those times. A variety of space types were logged including offices, conference rooms, rest rooms, hallways, and other common areas.

To ensure the hours of operation for the period observed were typical for the spaces the lighting audit team interviewed County staff. The hours of operation for the loggers were compared to the staff interviews. The hours of operation retrieved from the light logger information matched well with the hours of operation obtained during the interviews of the occupants by building.

The energy savings for the retrofits that include a reduction in operating hours (e.g., occupancy sensors) are based on the following calculation:

$$\text{kWh Saved} = \text{Qty} * \text{Unit } kW_{before} * \text{Sensor Reduction Factor}$$

The sensor reduction factor is based on data logger information that was recorded for various usage type areas.

The annual operating cost savings are based on the replacement costs for ballasts and lamps as shown in the following calculation. Note that no labor savings are included, only material replacement costs. The replacement cost savings are shown in Table 11 using the equation below.

$$\text{Replacement Cost Savings} = \text{Quantity} \times (\text{Rated Life/Annual Operating Hours}) \times \text{Unit Material Cost}$$

Table 11 – Lighting Lamp & Ballast Material Cost Savings

Components	Type	Avg Annual Run Hours	Avg Rated Life (hours)	Item Qty	Item Mat'l Cost	Item Life in Years	Unit Annual Cost per Item	Total Annual Line Item Cost
CFL Lamp	Lamp	4,134	12,000	335	$6.09	2.9	$2.10	$702.77
Incandescent Lamp	Lamp	2,145	12,000	108	$3.00	5.6	$0.54	$57.91

HID Lamp	Lamp	4,380	12,000	129	$23.33	2.7	$8.52	$1,098.49
T-12 Fluorescent 2' Linear	Lamp	1,365	12,000	5	$3.50	8.8	$0.40	$1.99
T-8 Fluorescent 3' Linear	Lamp	4,536	12,000	6	$5.00	2.6	$1.89	$11.34
T-12 Fluorescent 4' Linear	Lamp	1559.42	12,000	732	$3.50	7.7	$0.45	$332.94
T-12 Fluorescent 8' Linear	Lamp	217	12,000	2	$6.00	55.3	$0.11	$0.22
T-5 Fluorescent 4' Linear	Lamp	3,229	12,000	172	$4.50	3.7	$1.21	$208.29
T-8 Fluorescent 2' Linear	Lamp	3,923	12,000	92	$4.25	3.1	$1.39	$127.81
T-8 Fluorescent 4' Linear	Lamp	2,784	12,000	5947	$3.54	4.3	$0.82	$4,884.35
T-8 Fluorescent U Tube	Lamp	3,511	12,000	295	$5.00	3.4	$1.46	$431.56
T-8 Fluorescent 6' Linear	Lamp	7,331	12,000	7	$5.00	1.6	$3.05	$21.38
T-8 Fluorescent 8' Linear	Lamp	5,655	12,000	120	$5.00	2.1	$2.36	$282.73
T-5 Fluorescent 1' Linear	Lamp	3,172	12,000	63	$10.00	3.8	$2.64	$166.54
HID	Ballast	4,380	100,000	129	$115.00	22.8	$5.04	$649.77
T-12 Fluorescent	Ballast	1,047	100,000	199	$25.00	95.5	$0.26	$52.10
T-5 Fluorescent	Ballast	3,201	100,000	109	$25.00	31.2	$0.80	$87.22
T-8 Fluorescent	Ballast	4,623	100,000	2775	$25.00	21.6	$1.16	$3,207.39
Total Annual Maintenance Costs for Existing Lamps and Ballasts								$12,325

Baseline Usage and Cost

The energy baseline for this FIM is defined as the existing annual electric energy usage and lamp/ballast replacement costs for lighting at these facilities as shown in the table below.

Electrical Consumption (kWh/yr)	Electrical Annual Cost ($/yr)	Lamp/Ballast Annual Replacement Cost ($/yr)	Total Annual Cost ($/yr)
890,540	$84,221	$12,325	$96,546

Post Retrofit Energy Use and Cost

The projected energy use and cost for this FIM are shown in the table below.

Electrical Consumption (kWh/yr)	Electrical Annual Cost ($/yr)	Lamp/Ballast Annual Replacement Cost ($/yr)	Total Annual Cost ($/yr)
339,687	$33,173	$0	$33,173

The savings are the difference between the Baseline and the Post Retrofit energy use and cost multiplied by a safety factor of 0.95 and the annual replacement savings as summarized in the table that follows.

Guaranteed Electrical Consumption Savings (kWh/yr)	Guaranteed Electrical Annual Cost Savings ($/yr)	Annual Replacement Cost Savings ($/yr)	Total Annual Cost Saving ($/yr)
523,310	$48,495	$12,325	$60,820

Utility Incentives

SmartWatt will apply for incentives through National Grid's energy efficiency program. SmartWatt anticipates an incentive of $72,162 for this FIM.

FIM #2: Replace Water Source Heat Pumps

Annual Cost Savings	Implementation Cost	Incentive/Rebate
$81,103	$1,504,219	$32,893

Facilities Affected

This FIM will be completed in the following buildings:

- DSS
- Jail
- Veterans Building

Observation

The buildings listed above are heated and cooled through the use of water source heat pumps (WSHPs). The WSHPs are controlled via an N2 legacy Metasys controller that is not BACNET compatible. The WSHPs have reached their end of life and are failing at an increasing rate. In addition, the lack of BACNET compatible controllers has resulted in additional time and cost when the units are replaced. There are a total of 112 WSHPs as described in Table 12.

Table 12 – Existing WSHP Sizes and Ratings
DSS Building (51 WSHPs)

Room	Manufacturer	Model	Year Installed	Heating Capacity (MBH)	COP	Cooling (MBH)	EER
Storage - 1	McQuay	CCH024C	1994	29.6	4.1	26.1	13.6
Storage - 1	McQuay	CCH042C	1994	49.1	4.0	42.5	13.2
121	McQuay	CCH019C	1994	23.1	4.0	19.2	14.5
119	McQuay	CCH019C	1994	23.1	4.0	19.2	14.5
119	McQuay	CCH007C	1994	9.7	3.9	7.6	12.6
119	McQuay	CCH007C	1994	9.7	3.9	7.6	12.6
122	McQuay	CCH042C	1994	49.1	4.0	42.5	13.2
122	McQuay	CCH030C	1994	38.9	4.0	31.5	13.5
Vestibule	McQuay	WMHC018C	2012	21.1	4.6	18.9	18.5
Vestibule	McQuay	WMHC018C	2012	21.1	4.6	18.9	18.5
Storage - 1	McQuay	CCH036C	1994	42.1	4.1	37.9	13.7
Storage - 1	McQuay	CCH036C	1994	42.1	4.1	37.9	13.7
Storage - 1	McQuay	CCH036C	1994	42.1	4.1	37.9	13.7
Vestibule	McQuay	WMH019C	1994	19.6	3.3	17.1	13.9
Boiler - 8	McQuay	LHP010D	1994	117.8	3.7	111.9	13.6
Boiler - 8	McQuay	LHP010D	1994	118.4	3.8	112.9	13.6
128	McQuay	CCH019C	1994	23.1	4.0	19.2	14.5
131	McQuay	CCH024C	1994	29.6	4.1	26.1	13.6
131	Bosch	LV018	2004	22.7	4.8	21.4	17.0

Room	Manufacturer	Model	Year Installed	Heating Capacity (MBH)	COP	Cooling (MBH)	EER
131	McQuay	CCH024C	1994	29.6	4.1	26.1	13.6
111	Bosch	LV042	2004	48.7	4.8	44.4	16.8
103	McQuay	CCH042C	1994	49.1	4.0	42.5	13.2
102	McQuay	CCH007C	1994	9.7	3.9	7.6	12.6
111	McQuay	CCH007C	1994	9.7	3.9	7.6	12.6
111	McQuay	CCH009C	1994	11.9	4.0	9.4	12.7
111	McQuay	CCH036C	1994	42.1	4.1	37.9	13.7
140	McQuay	CCH030C	1994	38.9	4.0	31.5	13.5
142	McQuay	CCH036C	1994	42.1	4.1	37.9	13.7
142	McQuay	CCH019C	1994	23.1	4.0	19.2	14.5
142	McQuay	CCH030C	1994	38.9	4.0	31.5	13.5
128	McQuay	CCH036C	1994	42.1	4.1	37.9	13.7
128	McQuay	CCH036C	1994	42.1	4.1	37.9	13.7
128	McQuay	CCH019C	1994	23.1	4.0	19.2	14.5
207	McQuay	CCH042C	1994	49.1	4.0	42.5	13.2
201	McQuay	CCH019C	1994	23.1	4.0	19.2	14.5
211	McQuay	CCH009C	1994	11.9	4.0	9.4	12.7
211	McQuay	CCH019C	1994	23.1	4.0	19.2	14.5
222	McQuay	CCH030C	1994	38.9	4.0	31.5	13.5
222	McQuay	CCH024C	1994	29.6	4.1	26.1	13.6
222	McQuay	CCH030C	1994	38.9	4.0	31.5	13.5
222	McQuay	CCH036C	1994	42.1	4.1	37.9	13.7
222	McQuay	CCH036C	1994	42.1	4.1	37.9	13.7
253	Bosch	LV007	2013	7.8	5.3	6.1	12.2
253	McQuay	CCH030C	1994	38.9	4.0	31.5	13.5
253	McQuay	CCH007C	1994	9.7	3.9	7.6	12.6
253	McQuay	CCH007C	1994	9.7	3.9	7.6	12.6
241	McQuay	CCH036C	1994	42.1	4.1	37.9	13.7
241	McQuay	CCH030C	1994	38.9	4.0	31.5	13.5
241	Bosch	LV030	2013	34.8	4.7	32.7	17.9
205	Bosch	LV018	2013	22.7	4.8	21.4	17.0
206	McQuay	CCH019C	1994	23.1	4.0	19.2	14.5

Jail (39 WSHPs)

Room	Manufacturer	Model	Year Installed	Heating Capacity (MBH)	COP	Cooling (MBH)	EER
133	McQuay	CCH042	1985	49.1	4.0	42.5	13.2
111	McQuay	CCH030	1985	38.9	4.0	31.5	13.5
133	McQuay	CCH030	1985	38.9	4.0	31.5	13.5
156	McQuay	CCH023	1985	31.6	4.1	26.1	13.6
149	McQuay	CCH030	1985	38.9	4.0	31.5	13.5
147	McQuay	CCH042	1985	49.1	4.0	42.5	13.2
147	McQuay	CCH030	1985	38.9	4.0	31.5	13.5
123	McQuay	CCH023	1985	31.6	4.1	26.1	13.6
123	McQuay	CCH023	1985	31.6	4.1	26.1	13.6
166	McQuay	CCH030	1985	38.9	4.0	31.5	13.5
Above 200	McQuay	CCH030	1985	38.9	4.0	31.5	13.5
210A	McQuay	CCH023	1985	31.6	4.1	26.1	13.6
Isolation Area	McQuay	FCV009	1994	10.9	4.0	9.5	10.9
Above 200	McQuay	CCH030	1985	38.9	4.0	31.5	13.5
244	McQuay	CCH023	1985	31.6	4.1	26.1	13.6
Above 225	McQuay	CCH042	1985	49.1	4.0	42.5	13.2
Above 236	McQuay	CCH030	1985	38.9	4.0	31.5	13.5
Above 228	McQuay	CCH030	1985	38.9	4.0	31.5	13.5
Above 222	McQuay	CCH030	2013	38.9	4.0	31.5	13.5
Above 279	McQuay	CCH042	1985	49.1	4.0	42.5	13.2
Above 272	McQuay	CCH023	1985	31.6	4.1	26.1	13.6
Above 264	McQuay	CCH030	1985	38.9	4.0	31.5	13.5
Above 261	McQuay	CCH042	1/14/2013	49.1	4.0	42.5	13.2
Above 200	McQuay	CCH023	4/4/2012	31.6	4.1	26.1	13.6
188	McQuay	CCH050	1985	65.0	4.0	50.0	13.2
104	McQuay	CCH007	1994	9.1	3.9	7.6	12.6
118	McQuay	CCH019	1994	23.2	4.1	19.2	11.1
Hall Near 104	McQuay	CCH019	2015	23.2	4.0	19.2	14.5
118	McQuay	CCH007	1994	9.1	3.9	7.6	12.6
Hall Near 114	McQuay	CCH007	10/13/2012	9.1	3.9	7.6	12.6
Vestibule 112	McQuay	CCH019	1994	9.1	3.9	7.6	12.6
Waiting	McQuay	CCH019	1994	23.2	4.1	19.2	11.1
Kitchen	McQuay	CCH007	1994	9.1	3.9	7.6	12.6
Indoor Rec	McQuay	CCH019	9/10/2012	23.2	4.0	19.2	14.5
Basement MR	McQuay	FCV060	1994	75.0	4.0	65.1	10.6
Basement MR	McQuay	FCV060	1994	75.0	4.0	65.1	10.6
Basement MR	McQuay	FCV060	1994	75.0	4.0	65.1	10.6
Mezzanine	McQuay	FCV060	1994	75.0	4.0	65.1	10.6

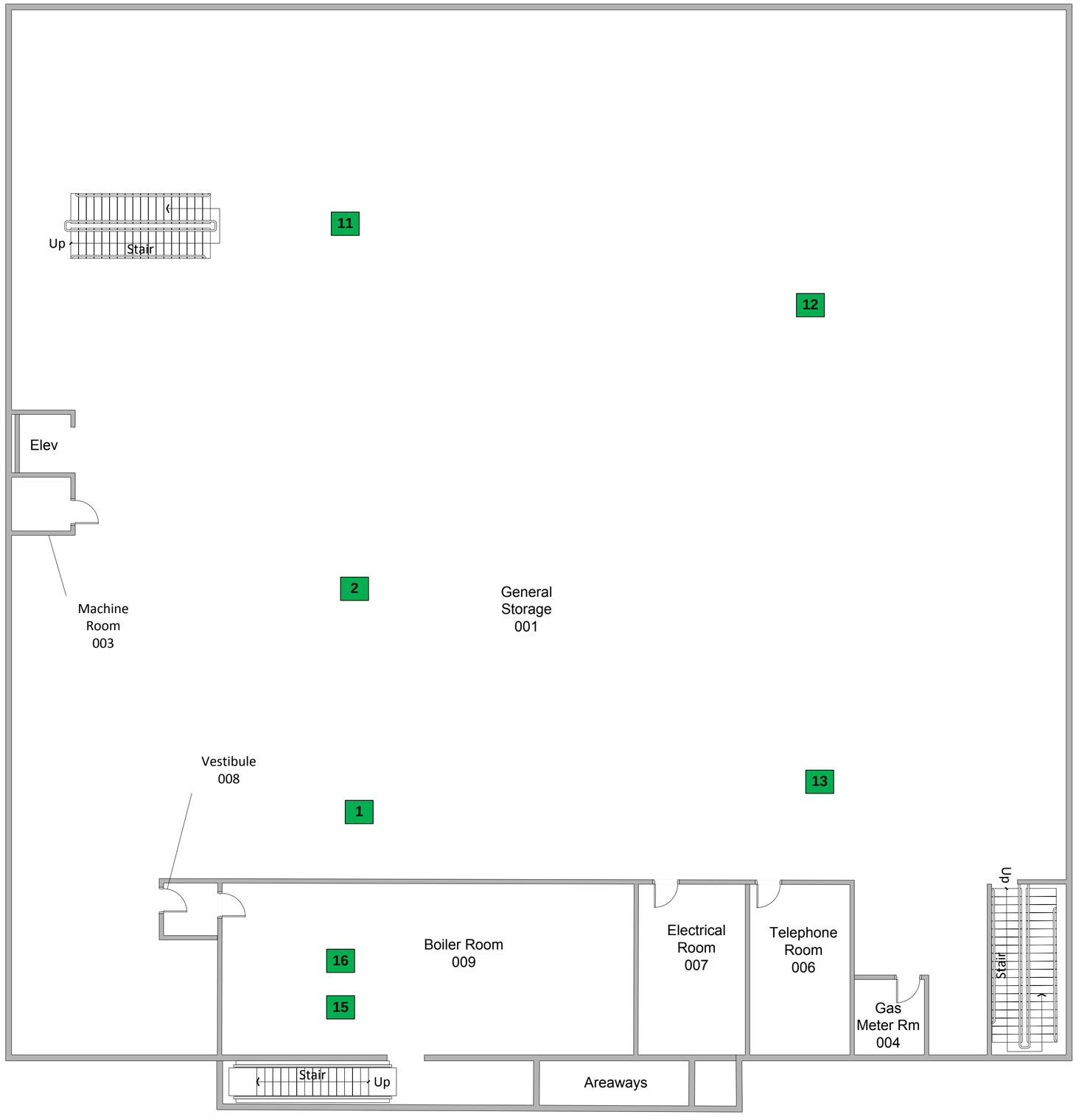
Room	Manufacturer	Model	Year Installed	Heating Capacity (MBH)	COP	Cooling (MBH)	EER
Mezzanine	McQuay	FCV060	1994	75.0	4.0	65.1	10.6

Veterans Building (22 WSHPs)

Room	Manufacturer	Model	Year Installed	Heating Capacity (MBH)	COP	Cooling (MBH)	EER
Hall near 127	Command Aire	SWPH 350EA	1988	48.0	4.0	36.0	11.0
Hall near 116	McQuay	CCH024A	2015	29.6	4.1	26.1	13.6
121	Command Aire	SWPH 350EA	1988	48.0	4.0	36.0	11.0
Hall near 113	McQuay	CCH024A	2013	29.6	4.1	26.1	13.6
Hall near 112	McQuay	CCH024A	2013	29.6	4.1	26.1	13.6
Mens BR	Command Aire	SWPH 280EA	1988	40.0	4.0	30.0	11.0
Lobby	Command Aire	SWPH 410EA	1988	53.0	4.0	42.0	11.0
Womens BR	Command Aire	SWPH 350EA	1988	48.0	4.0	36.0	11.0
144	Command Aire	SWPH 190EA	1988	24.5	4.0	18.5	11.0
143	Command Aire	SWPH 260EA	1988	32.0	4.1	24.0	11.0
Hall near 140	McQuay	CCH030A	2015	38.9	4.0	31.5	13.5
Hall near 219	Command Aire	SWPH 280EA	1988	40.0	4.0	30.0	11.0
215	Command Aire	SWPH 280EA	1988	40.0	4.0	30.0	11.0
Lounge	McQuay	CCH030A	2000	38.9	4.0	31.5	13.5
Hall near 211	McQuay	CCH024A	2001	29.6	4.1	26.1	13.6
Hall near 207	McQuay	CCH030A	2014	38.9	4.0	31.5	13.5
Observation Room	Command Aire	SWPH 190EA	1988	24.5	4.0	18.5	11.0
241	Command Aire	SWPH 260EA	1988	32.0	4.1	24.0	11.0
241	Command Aire	SWPH 350EA	1988	48.0	4.0	36.0	11.0
Hall near 230	Command Aire	SWPH 190EA	1988	24.5	4.0	18.5	11.0
Hall near 228	Command Aire	SWPH 410EA	1988	53.0	4.0	42.0	11.0

Recommendation

SmartWatt will replace ninety-six (96) of the existing 112 WSHPs with new Carrier units. WSHPs indicated on the drawings and schedules that follow will be replaced. Heat pumps to be replaced are indicated on each building section floor plan in green and units to remain in place are indicated in red. The drawings are based on original design and retrofit drawings as provided by Madison County staff. A schedule and list of accessories is included at the end of each building's drawings. The new heat pumps will be BACNET compatible. The units will be integrated to the existing JCI Metasys system.



Heat Pump Locations Basement

#	Heat pump to be replaced and ID Number
#	Heat pump to remain and ID Number

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Rev	Date	Description
00	11/5/15	
01		
02		
03		
04		
05		
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09		

Madison County - DSS

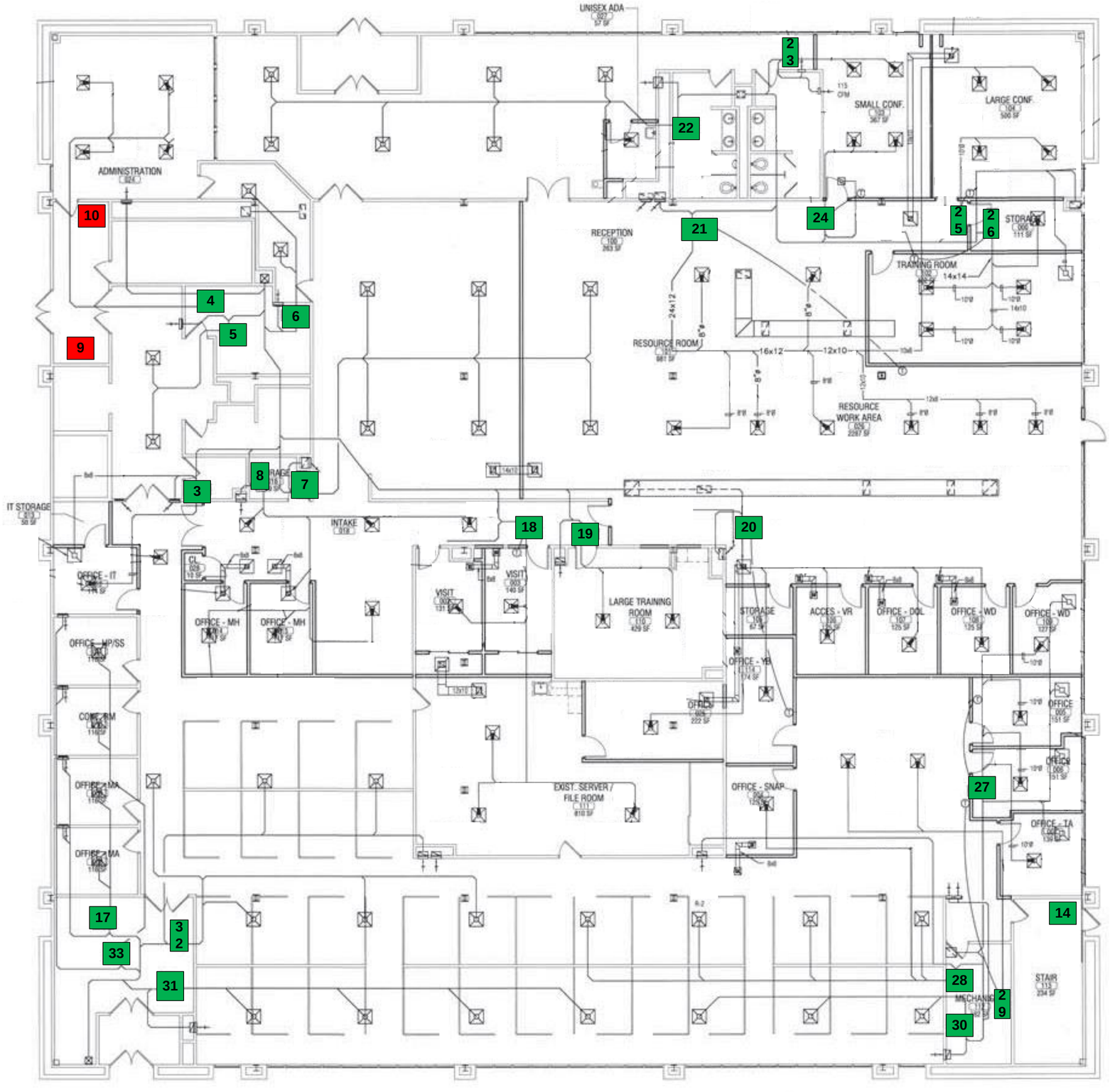
Heat Pump Replacement
Sheet 1

File: DSS WSHP 12-16-15.vsd

Page: DSS Basement

Printed: 11/17/2015

Engineer: WJC | Job:



Heat Pump Locations 1st Floor

#	Heat pump to be replaced and ID Number
#	Heat pump to remain and ID Number

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Rev	Date	Description
00	11/5/15	
01		
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Madison County - DSS

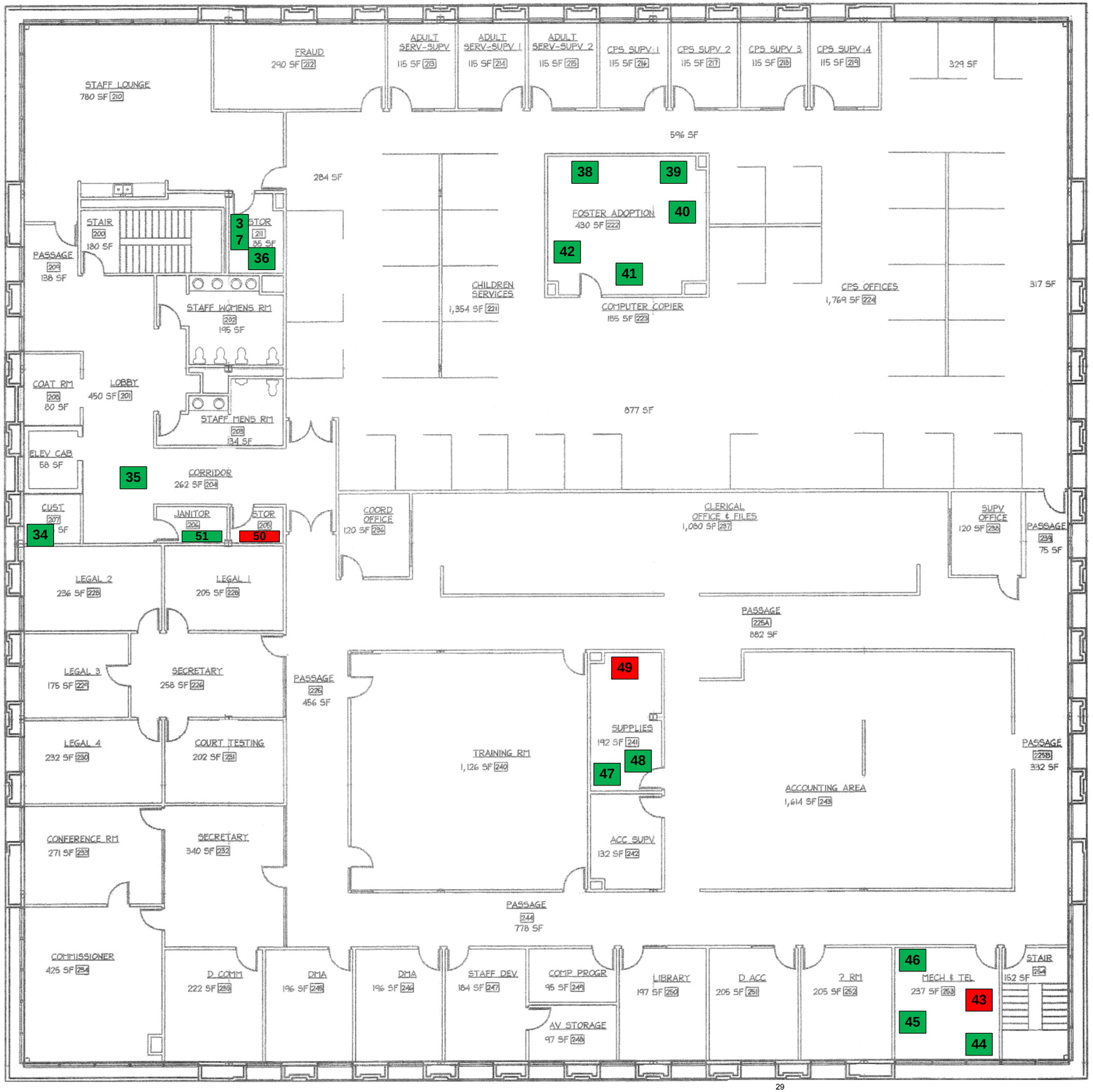
Heat Pump Replacement Sheet 2

File: DSS WSHP 12-16-15.vsd

Page: DSS 1st Floor

Printed: 11/17/2015

Engineer: WJC | Job:



Heat Pump Locations 2nd Floor

#	Heat pump to be replaced and ID Number
#	Heat pump to remain and ID Number

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Rev.	Date	Description
00	11/5/15	
01		
02		
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08		
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Madison County - DSS

Heat Pump Replacement Sheet 3

File: DSS WSHP 12-16-15.vsd

Page: DSS 2nd Floor

Printed: 11/17/2015

Engineer: WJC

Job:

						Replacement Heat Pumps				Heating Performance				Cooling Performance					Electrical				
Drawing ID #	Unit Tag	Replace	Floor	Room	Type	Manuf.	Model	Water Flow GPM	CFM	Heating Capacity (MBH)	COP	EAT db F	Power Input kW	Cooling (MBH)	EER	EAT db F	EAT wb F	Power Input kW	FLA	Voltage	PH	Hose Kit	Controller
1	F	Yes	Basement	Storage - 1	Horizontal	Carrier	50PSH024	6	800	31.4	5.4	70	1.72	27.5	22.3	80	67	1.08	16.3	208	1	Nexus - ACH0752	WSHP Open (BACnet)
2	I	Yes	Basement	Storage - 1	Horizontal	Carrier	50PSH042	10.5	1400	47.8	6	70	2.32	44.8	23.8	80	67	1.62	22.7	208	1	Nexus - ACH1002	WSHP Open (BACnet)
3	E	Yes	1st Floor	121	Horizontal	Carrier	50PSH019	4.5	600	22.4	5.2	70	1.33	20.5	20.9	80	67	0.98	10.2	208	1	Nexus - ACH0752	WSHP Open (BACnet)
4	E	Yes	1st Floor	119	Horizontal	Carrier	50PSH019	4.5	600	22.4	5.2	70	1.33	20.5	20.9	80	67	0.98	10.2	208	1	Nexus - ACH0752	WSHP Open (BACnet)
5	A	Yes	1st Floor	119	Horizontal	Carrier	50PSH007	1.5	285	8.6	5	70	0.51	7.4	16.8	80	67	0.32	3.46	208	1	Nexus - ACH0752	WSHP Open (BACnet)
6	A	Yes	1st Floor	119	Horizontal	Carrier	50PSH007	1.5	285	8.6	5	70	0.51	7.4	16.8	80	67	0.32	3.46	208	1	Nexus - ACH0752	WSHP Open (BACnet)
7	I	Yes	1st Floor	122	Horizontal	Carrier	50PSH042	10.5	1400	47.8	6	70	2.32	44.8	23.8	80	67	1.62	22.7	208	1	Nexus - ACH1002	WSHP Open (BACnet)
8	G	Yes	1st Floor	122	Horizontal	Carrier	50PSH030	7.5	1000	33.8	5.7	70	1.73	30.4	20.7	80	67	1.23	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
9	K	No	1st Floor	Foyer	Console																		
10	K	No	1st Floor	Foyer	Console																		
11	H	Yes	Basement	Storage - 1	Horizontal	Carrier	50PSH036	9	1200	46.4	5.8	70	2.34	37.8	20.1	80	67	1.49	22	208	1	Nexus - ACH1002	WSHP Open (BACnet)
12	H	Yes	Basement	Storage - 1	Horizontal	Carrier	50PSH036	9	1200	46.4	5.8	70	2.34	37.8	20.1	80	67	1.49	22	208	1	Nexus - ACH1002	WSHP Open (BACnet)
13	H	Yes	Basement	Storage - 1	Horizontal	Carrier	50PSH036	9	1200	46.4	5.8	70	2.34	37.8	20.1	80	67	1.49	22	208	1	Nexus - ACH1002	WSHP Open (BACnet)
14	K	Yes	1st Floor		Console	Carrier	50PEC09	2.3	350	11.3	5.4	70	0.62	10.2	20.5	80	67	0.42	4.1	208	1	N/A	WSHP Open (BACnet)
15	HP-1	Yes	Basement	Boiler - 8	Vertical	Carrier	50VQP120	30	3320	158.2	4.7	70	9.78	131.8	18.5	80	67	6.43	21.8	208	3	Nexus - ACH1502	WSHP Open (BACnet)
16	HP-2	Yes	Basement	Boiler - 8	Vertical	Carrier	50VQP120	30	3320	158.2	4.7	70	9.78	131.8	18.5	80	67	6.43	21.8	208	3	Nexus - ACH1502	WSHP Open (BACnet)
17	E	Yes	1st Floor	128	Horizontal	Carrier	50PSH019	4.5	600	22.4	5.2	70	1.33	20.5	20.9	80	67	0.98	10.2	208	1	Nexus - ACH0752	WSHP Open (BACnet)
18	F	Yes	1st Floor	131	Horizontal	Carrier	50PSH024	6	800	31.4	5.4	70	1.72	27.5	22.3	80	67	1.08	16.3	208	1	Nexus - ACH0752	WSHP Open (BACnet)
19	E	Yes	1st Floor	131	Horizontal	Carrier	50PSH019	4.5	600	22.4	5.2	70	1.33	20.5	20.9	80	67	0.98	10.2	208	1	Nexus - ACH0752	WSHP Open (BACnet)
20	F	Yes	1st Floor	131	Horizontal	Carrier	50PSH024	6	800	31.4	5.4	70	1.72	27.5	22.3	80	67	1.08	16.3	208	1	Nexus - ACH0752	WSHP Open (BACnet)
21	I	Yes	1st Floor	111	Horizontal	Carrier	50PSH042	10.5	1400	47.8	6	70	2.32	44.8	23.8	80	67	1.62	22.7	208	1	Nexus - ACH1002	WSHP Open (BACnet)
22	I	Yes	1st Floor	103	Horizontal	Carrier	50PSH042	10.5	1400	47.8	6	70	2.32	44.8	23.8	80	67	1.62	22.7	208	1	Nexus - ACH1002	WSHP Open (BACnet)
23	A	Yes	1st Floor	102	Horizontal	Carrier	50PSH007	1.5	285	8.6	5	70	0.51	7.4	16.8	80	67	0.32	3.46	208	1	Nexus - ACH0752	WSHP Open (BACnet)
24	A	Yes	1st Floor	111	Horizontal	Carrier	50PSH007	1.5	285	8.6	5	70	0.51	7.4	16.8	80	67	0.32	3.46	208	1	Nexus - ACH0752	WSHP Open (BACnet)
25	B	Yes	1st Floor	111	Horizontal	Carrier	50PSH007	1.5	285	8.6	5	70	0.51	7.4	16.8	80	67	0.32	3.46	208	1	Nexus - ACH0752	WSHP Open (BACnet)
26	H	Yes	1st Floor	111	Horizontal	Carrier	50PSH036	9	1200	46.4	5.8	70	2.34	37.8	20.1	80	67	1.49	22	208	1	Nexus - ACH1002	WSHP Open (BACnet)
27	G	Yes	1st Floor	140	Horizontal	Carrier	50PSH030	7.5	1000	33.8	5.7	70	1.73	30.4	20.7	80	67	1.23	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
28	H	Yes	1st Floor	142	Horizontal	Carrier	50PSH036	9	1200	46.4	5.8	70	2.34	37.8	20.1	80	67	1.49	22	208	1	Nexus - ACH1002	WSHP Open (BACnet)
29	E	Yes	1st Floor	142	Horizontal	Carrier	50PSH019	4.5	600	22.4	5.2	70	1.33	20.5	20.9	80	67	0.98	10.2	208	1	Nexus - ACH0752	WSHP Open (BACnet)
30	G	Yes	1st Floor	142	Horizontal	Carrier	50PSH030	7.5	1000	33.8	5.7	70	1.73	30.4	20.7	80	67	1.23	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
31	H	Yes	1st Floor	128	Horizontal	Carrier	50PSH036	9	1200	46.4	5.8	70	2.34	37.8	20.1	80	67	1.49	22	208	1	Nexus - ACH1002	WSHP Open (BACnet)
32	H	Yes	1st Floor	128	Horizontal	Carrier	50PSH036	9	1200	46.4	5.8	70	2.34	37.8	20.1	80	67	1.49	22	208	1	Nexus - ACH1002	WSHP Open (BACnet)
33	E	Yes	1st Floor	128	Horizontal	Carrier	50PSH019	4.5	600	22.4	5.2	70	1.33	20.5	20.9	80	67	0.98	10.2	208	1	Nexus - ACH0752	WSHP Open (BACnet)
34	I	Yes	2nd Floor	207	Horizontal	Carrier	50PSH042	10.5	1400	47.8	6	70	2.32	44.8	23.8	80	67	1.62	22.7	208	1	Nexus - ACH1002	WSHP Open (BACnet)
35	E	Yes	2nd Floor	201	Horizontal	Carrier	50PSH019	4.5	600	22.4	5.2	70	1.33	20.5	20.9	80	67	0.98	10.2	208	1	Nexus - ACH0752	WSHP Open (BACnet)
36	B	Yes	2nd Floor	211	Horizontal	Carrier	50PSH007	1.5	285	8.6	5	70	0.51	7.4	16.8	80	67	0.32	3.46	208	1	Nexus - ACH0752	WSHP Open (BACnet)
37	E	Yes	2nd Floor	211	Horizontal	Carrier	50PSH019	4.5	600	22.4	5.2	70	1.33	20.5	20.9	80	67	0.98	10.2	208	1	Nexus - ACH0752	WSHP Open (BACnet)
38	G	Yes	2nd Floor	222	Horizontal	Carrier	50PSH030	7.5	1000	33.8	5.7	70	1.73	30.4	20.7	80	67	1.23	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
39	F	Yes	2nd Floor	222	Horizontal	Carrier	50PSH024	6	800	31.4	5.4	70	1.72	27.5	22.3	80	67	1.08	16.3	208	1	Nexus - ACH0752	WSHP Open (BACnet)
40	G	Yes	2nd Floor	222	Horizontal	Carrier	50PSH030	7.5	1000	33.8	5.7	70	1.73	30.4	20.7	80	67	1.23	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
41	H	Yes	2nd Floor	222	Horizontal	Carrier	50PSH036	9	1200	46.4	5.8	70	2.34	37.8	20.1	80	67	1.49	22	208	1	Nexus - ACH1002	WSHP Open (BACnet)
42	H	Yes	2nd Floor	222	Horizontal	Carrier	50PSH036	9	1200	46.4	5.8	70	2.34	37.8	20.1	80	67	1.49	22	208	1	Nexus - ACH1002	WSHP Open (BACnet)
43	I	No	2nd Floor	253	Horizontal																		
44	G	Yes	2nd Floor	253	Horizontal	Carrier	50PSH030	7.5	1000	33.8	5.7	70	1.73	30.4	20.7	80	67	1.23	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
45	A	Yes	2nd Floor	253	Horizontal	Carrier	50PSH007	1.5	285	8.6	5	70	0.51	7.4	16.8	80	67	0.32	3.46	208	1	Nexus - ACH0752	WSHP Open (BACnet)
46	E	Yes	2nd Floor	253	Horizontal	Carrier	50PSH019	4.5	600	22.4	5.2	70	1.33	20.5	20.9	80	67	0.98	10.2	208	1	Nexus - ACH0752	WSHP Open (BACnet)
47	H	Yes	2nd Floor	241	Horizontal	Carrier	50PSH036	9	1200	46.4	5.8	70	2.34	37.8	20.1	80	67	1.49	22	208	1	Nexus - ACH1002	WSHP Open (BACnet)
48	G	Yes	2nd Floor	241	Horizontal	Carrier	50PSH030	7.5	1000	33.8	5.7	70	1.73	30.4	20.7	80	67	1.23	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
49	G	No	2nd Floor	241	Horizontal																		
50	E	No	2nd Floor	205	Horizontal																		
51	E	Yes	2nd Floor	206	Horizontal	Carrier	50PSH019	4.5	600	22.4	5.2	70	1.33	20.5	20.9	80	67	0.98	10.2	208	1	Nexus - ACH0752	WSHP Open (BACnet)

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Madison County - DSS

Heat Pump Replacement Sheet 4

File: DSS WSHP 12-16-15.vsd
Page: Schedule Page 1
Printed: 11/17/2015
Engineer: WJC | Job:

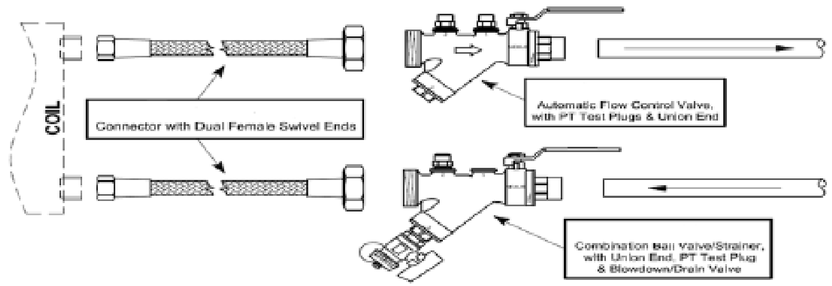
Replacement Heat Pumps Summary						
Bldg	Unit Tag	Number of Units to be Replaced	Voltage	Phase	Manuf.	Model
DSS	A	5	208	1	Carrier	50PSH007
DSS	B	2	208	1	Carrier	50PSH007
DSS	E	10	208	1	Carrier	50PSH019
DSS	F	4	208	1	Carrier	50PSH024
DSS	G	7	208	1	Carrier	50PSH030
DSS	H	10	208	1	Carrier	50PSH036
DSS	I	5	208	1	Carrier	50PSH042
DSS	K	1	208	1	Carrier	50PEC09
DSS	HP-1	1	208	3	Carrier	50VQP120
DSS	HP-2	1	208	3	Carrier	50VQP120
Total		46				

Stainless Steel Hose Kit

AHC** 1/2" to 2" Stainless Steel Braided Hose Kit –** Hose kit with a manual shut off valve, auto flow regulator to maintain set GPM and Y strainer for hard water applications. Automatic balancing valves provide a constant flow rate; if the pressure changes (ex. Additional heat pumps) each flow control valve will adjust to the conditions. The Y strainer can filter water with high mineral content which can cause damage over time to equipment.

Specifications:

- Designed for water source heat pump applications.
- Kevlar® reinforced EPDM hose core with stainless steel hose braid
- Swivel connection with dual female ends provides union between heat pump and piping system.
- Brass OT58 fittings
- Ball valve with integral P/T (pressure/temperature) ports and union end



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Madison County - DSS

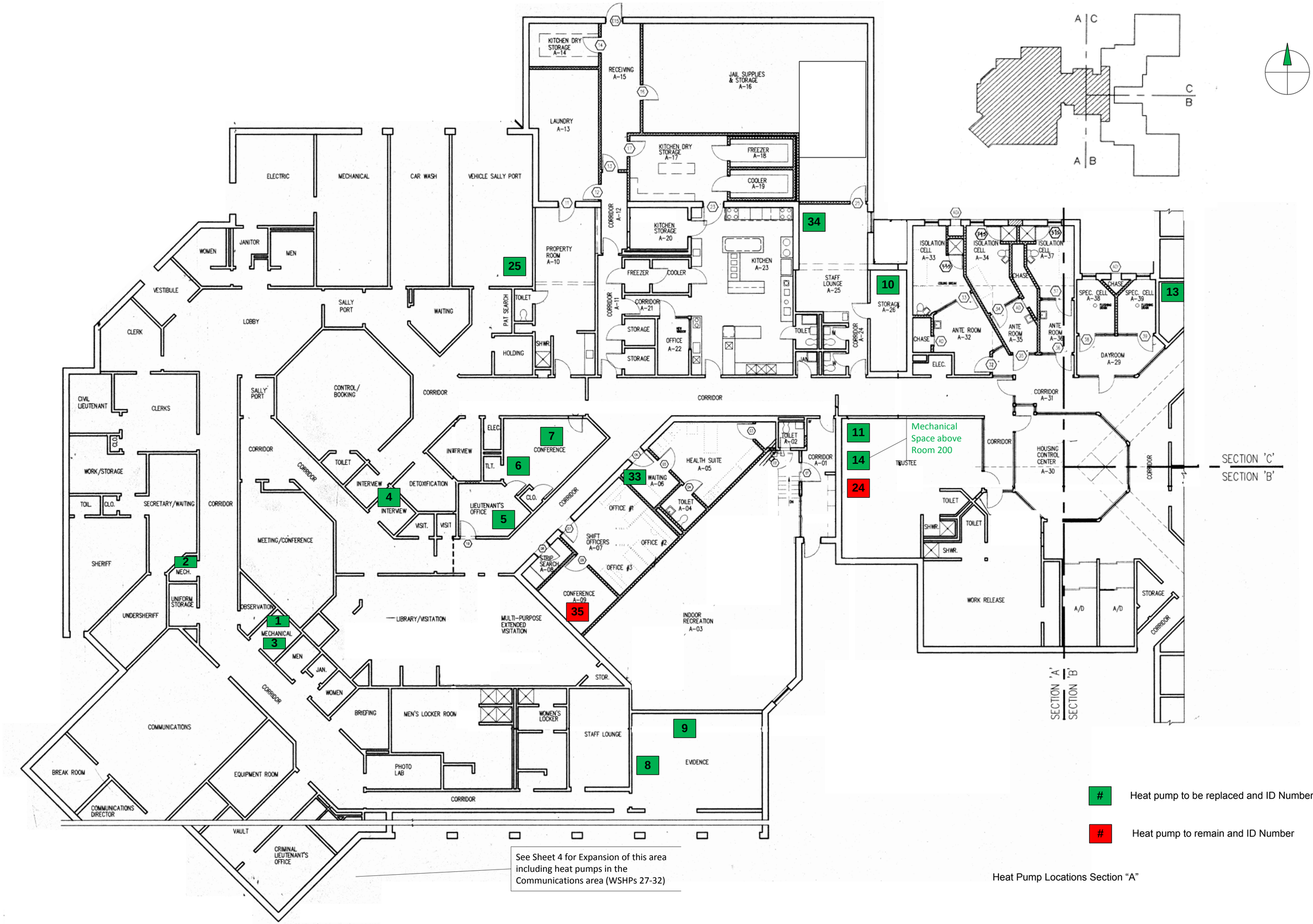
Heat Pump Replacement Sheet 5

File: DSS WSHP 12-16-15.vsd

Page: Schedule Page 2

Printed: 11/17/2015

Engineer: WJC | Job:



See Sheet 4 for Expansion of this area including heat pumps in the Communications area (WSHPs 27-32)

Heat pump to be replaced and ID Number

Heat pump to remain and ID Number

Heat Pump Locations Section “A”

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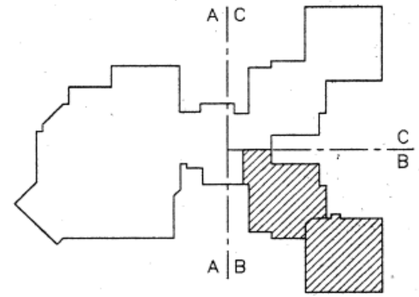
Madison County - Jail

Heat Pump Replacement Sheet 1

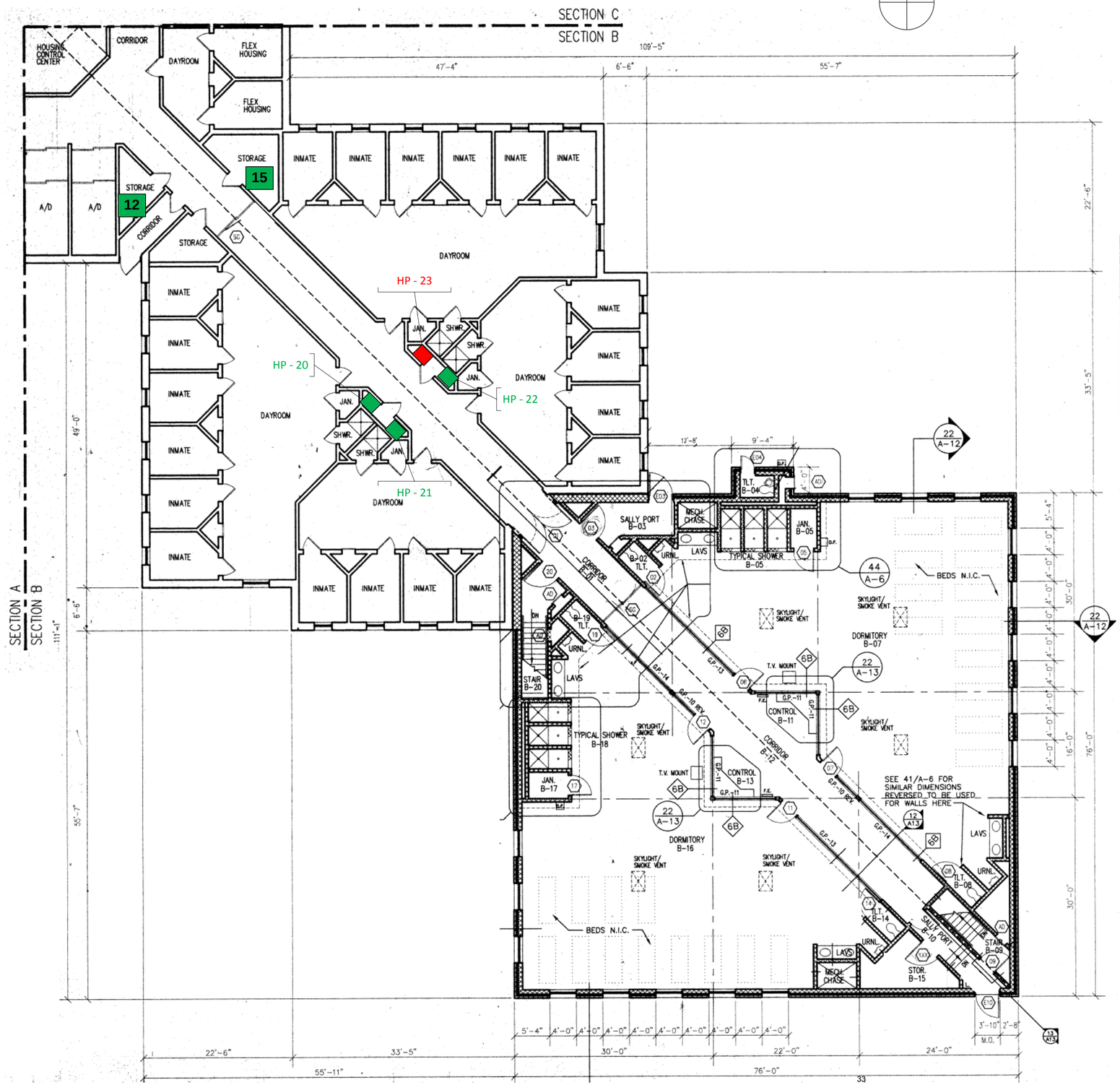
File: Madison County Jail WSHP Updated 12-16-15.vsd
Page: Jail-A
Printed: 11/16/2015
Engineer: WJC
Job:

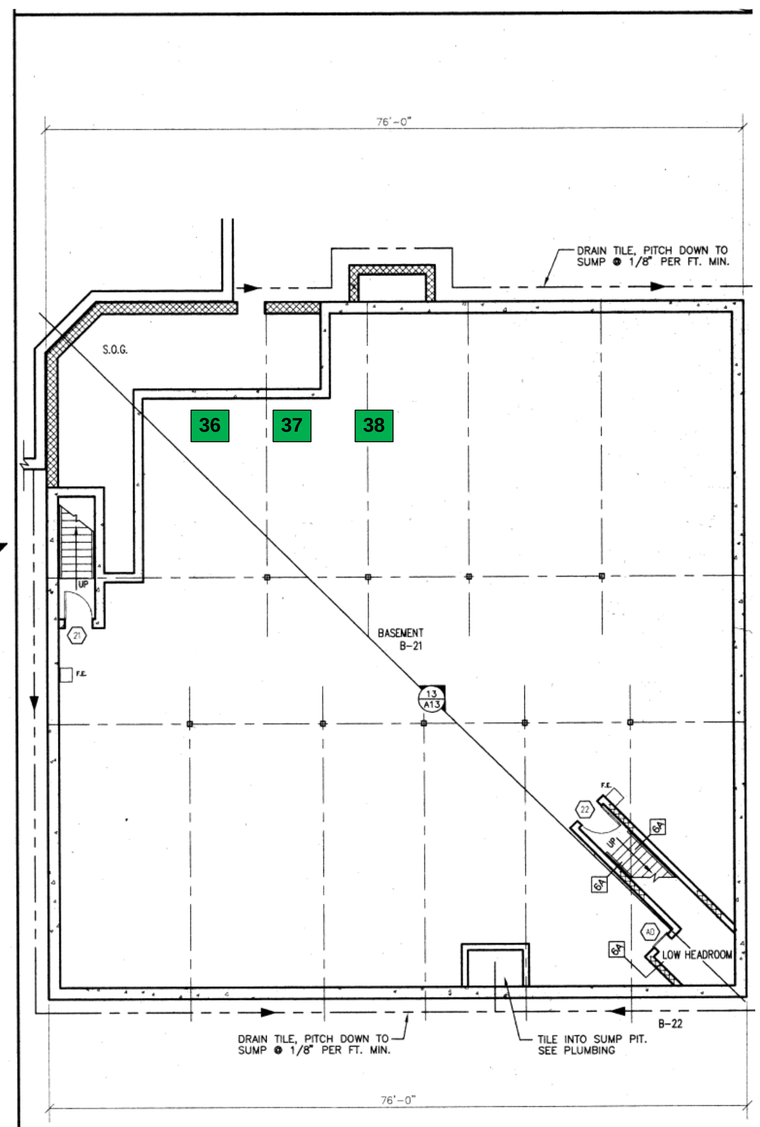
Heat Pump Locations Section “B”



Heat pump to be replaced and ID Number

Heat pump to remain and ID Number





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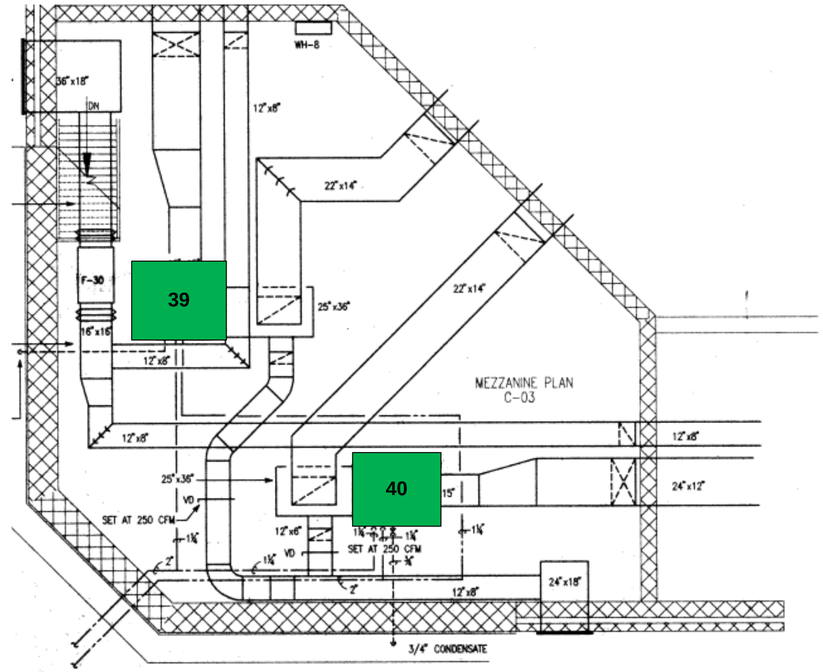
Madison County - Jail

Heat Pump Replacement Sheet 2

File: Madison County Jail WSHP Updated 12-16-15.vpd
Page: Jail-B
Printed: 11/16/2015
Engineer: WJC
Job:

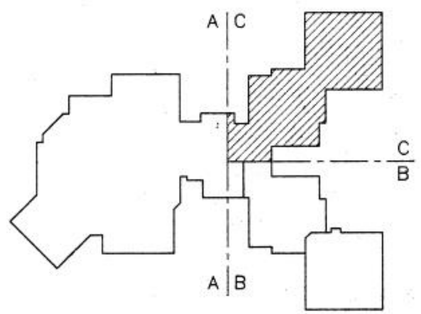


MEZZANINE PLAN

SCALE: 1/4" = 1'-0"

Heat Pump Locations Section "C"

- # Heat pump to be replaced and ID Number
- # Heat pump to remain and ID Number



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Madison County - Jail

Heat Pump Replacement Sheet 3

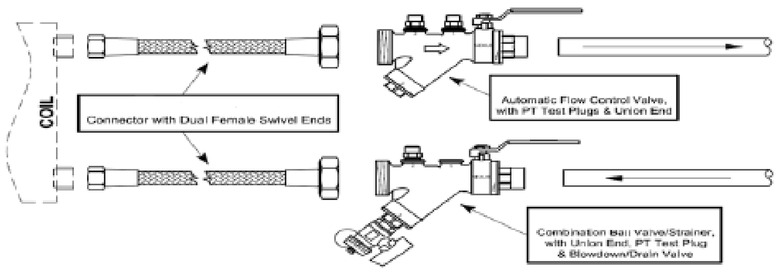
File: Madison County Jail WSHP Updated 12-16-15.vsd
Page: Jail-C
Printed: 11/16/2015
Engineer: WJC
Job:

Stainless Steel Hose Kit

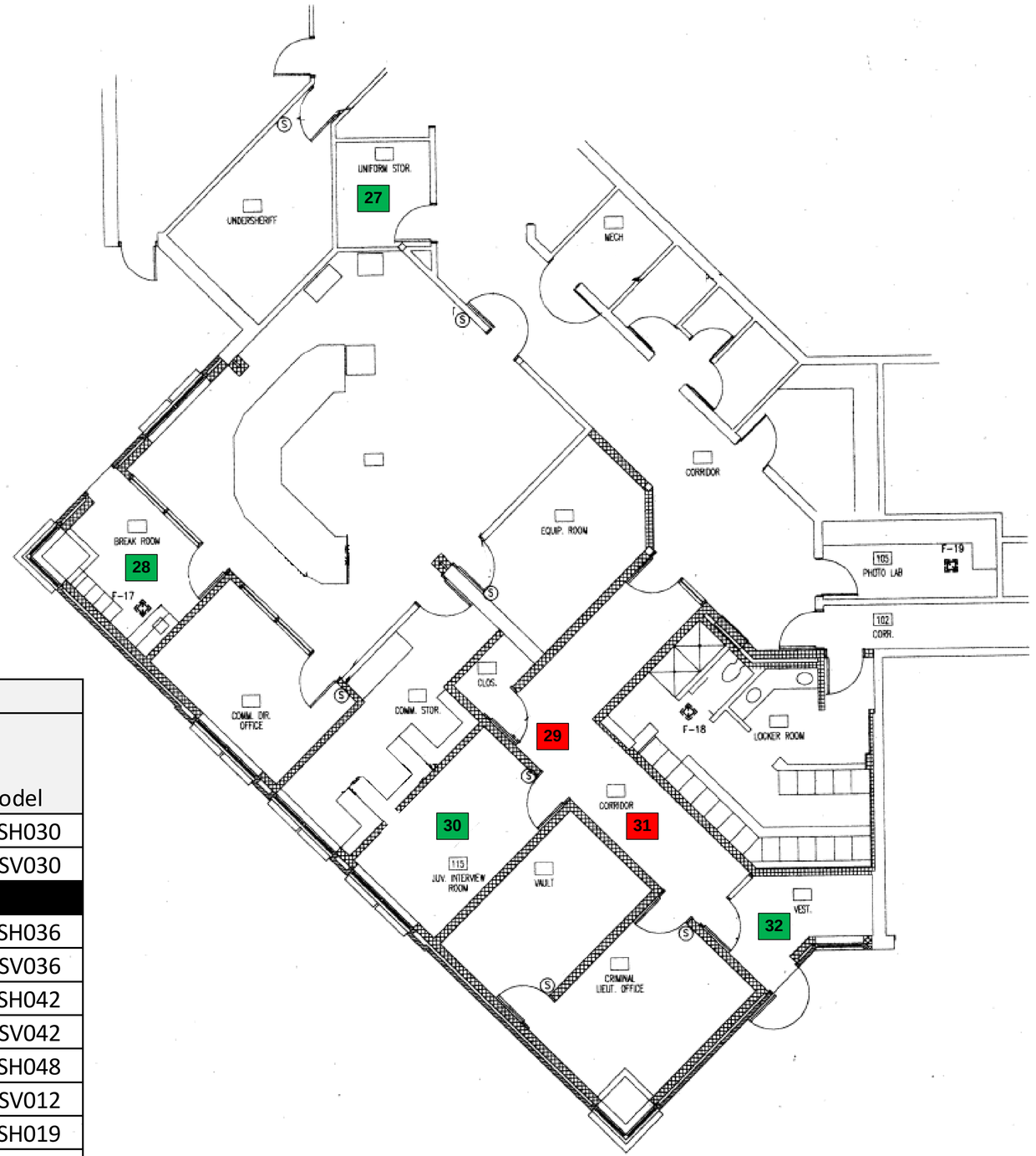
AHC** 1/2" to 2" Stainless Steel Braided Hose Kit** – Hose kit with a manual shut off valve, auto flow regulator to maintain set GPM and Y strainer for hard water applications. Automatic balancing valves provide a constant flow rate; if the pressure changes (ex. Additional heat pumps) each flow control valve will adjust to the conditions. The Y strainer can filter water with high mineral content which can cause damage over time to equipment.

Specifications:

- Designed for water source heat pump applications.
- Kevlar® reinforced EPDM hose core with stainless steel hose braid
- Swivel connection with dual female ends provides union between heat pump and piping system.
- Brass OT58 fittings
- Ball valve with integral P/T (pressure/temperature) ports and union end



Replacement Heat Pumps Summary						
Bldg	Unit Tag	Number of Units to be Replaced	Voltage	Phase	Manuf.	Model
Jail	A	1	208	1	Carrier	50PSH030
Jail	B	2	208	1	Carrier	50PSV030
Jail	C	0	208	1		
Jail	D	2	208	3	Carrier	50PSH036
Jail	E	9	208	3	Carrier	50PSV036
Jail	F	1	208	3	Carrier	50PSH042
Jail	G	4	208	3	Carrier	50PSV042
Jail	H	1	208	3	Carrier	50PSH048
Jail	I	1	208	1	Carrier	50PSV012
Jail	J	3	208	1	Carrier	50PSH019
Jail	K	4	120	1	Carrier	50PSH012
Jail	L	5	208	3	Carrier	50PSV060
Total		33				



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Madison County - Jail

Heat Pump Replacement Sheet 4

File: Madison County Jail WSHP Updated 12-16-15.vsd
Page: Callout-1
Printed: 11/16/2015
Engineer: WJC
Job:

						Replacement Heat Pumps				Heating Performance				Cooling Performance					Electrical				
Drawing ID #	Unit Tag	Replace	Bldg Section	Room	Type	Manuf.	Model	Water Flow GPM	CFM	Heating Capacity (MBH)	COP	EAT db F	Power Input kW	Cooling (MBH)	EER	EAT db F	EAT wb F	Power Input kW	FLA	Voltage	PH	Hose Kit	Controller
1	G	Yes	A	133	Vertical	Carrier	50PSV042	10.5	1400	47.8	6	70	2.32	44.8	23.8	80	67	1.62	16.4	208	3	Nexus - ACH1002	WSHP Open (BACnet)
2	E	Yes	A	111	Vertical	Carrier	50PSV036	9	1100	46.4	5.8	70	2.36	37.8	20.1	80	67	1.49	16	208	3	Nexus - ACH1002	WSHP Open (BACnet)
3	E	Yes	A	133	Vertical	Carrier	50PSV036	9	1100	46.4	5.8	70	2.36	37.8	20.1	80	67	1.49	16	208	3	Nexus - ACH1002	WSHP Open (BACnet)
4	A	Yes	A	156	Horizontal	Carrier	50PSH030	7.5	900	33.8	5.7	70	1.73	30.4	21.3	80	67	1.22	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
5	D	Yes	A	149	Horizontal	Carrier	50PSH036	9	1100	46.4	5.8	70	2.36	37.8	20.1	80	67	1.49	16	208	3	Nexus - ACH1002	WSHP Open (BACnet)
6	F	Yes	A	147	Horizontal	Carrier	50PSH042	10.5	1400	47.8	6	70	2.32	44.8	23.8	80	67	1.62	16.4	208	3	Nexus - ACH1002	WSHP Open (BACnet)
7	D	Yes	A	147	Horizontal	Carrier	50PSH036	9	1100	46.4	5.8	70	2.36	37.8	20.1	80	67	1.49	16	208	3	Nexus - ACH1002	WSHP Open (BACnet)
8	A	Yes	A	123	Horizontal	Carrier	50PSH030	7.5	900	33.8	5.7	70	1.73	30.4	21.3	80	67	1.22	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
9	A	Yes	A	123	Horizontal	Carrier	50PSH030	7.5	900	33.8	5.7	70	1.73	30.4	21.3	80	67	1.22	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
10	E	Yes	A	166	Vertical	Carrier	50PSV036	9	1100	46.4	5.8	70	2.36	37.8	20.1	80	67	1.49	16	208	3	Nexus - ACH1002	WSHP Open (BACnet)
11	E	Yes	A	Above 200	Vertical	Carrier	50PSV036	9	1100	46.4	5.8	70	2.36	37.8	20.1	80	67	1.49	16	208	3	Nexus - ACH1002	WSHP Open (BACnet)
12	B	Yes	B	210A	Vertical	Carrier	50PSV030	7.5	900	33.8	5.7	70	1.73	30.4	21.3	80	67	1.22	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
13	I	Yes	A	Isolation Area	Vertical	Carrier	50PSV012	3	335	15.7	4.52	70	1.22	12.7	17.1	80	67	0.74	5.56	208	1	Nexus - ACH0752	WSHP Open (BACnet)
14	E	Yes	A	Above 200	Vertical	Carrier	50PSV036	9	1100	46.4	5.8	70	2.36	37.8	20.1	80	67	1.49	16	208	3	Nexus - ACH1002	WSHP Open (BACnet)
15	B	Yes	B	244	Vertical	Carrier	50PSV030	7.5	900	33.8	5.7	70	1.73	30.4	21.3	80	67	1.22	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
16	G	Yes	C	Above 225	Vertical	Carrier	50PSV042	10.5	1400	47.8	6	70	2.32	44.8	23.8	80	67	1.62	16.4	208	3	Nexus - ACH1002	WSHP Open (BACnet)
17	E	Yes	C	Above 236	Vertical	Carrier	50PSV036	9	1100	46.4	5.8	70	2.36	37.8	20.1	80	67	1.49	16	208	3	Nexus - ACH1002	WSHP Open (BACnet)
18	E	Yes	C	Above 228	Vertical	Carrier	50PSV036	9	1100	46.4	5.8	70	2.36	37.8	20.1	80	67	1.49	16	208	3	Nexus - ACH1002	WSHP Open (BACnet)
19	E	No	C	Above 222	Vertical																		
20	G	Yes	B	Above 279	Vertical	Carrier	50PSV042	10.5	1400	47.8	6	70	2.32	44.8	23.8	80	67	1.62	16.4	208	3	Nexus - ACH1002	WSHP Open (BACnet)
21	B	Yes	B	Above 272	Vertical	Carrier	50PSV030	7.5	900	33.8	5.7	70	1.73	30.4	21.3	80	67	1.22	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
22	E	Yes	B	Above 264	Vertical	Carrier	50PSV036	9	1100	46.4	5.8	70	2.36	37.8	20.1	80	67	1.49	16	208	3	Nexus - ACH1002	WSHP Open (BACnet)
23	G	No	B	Above 261	Vertical																		
24	C	No	A	Above 200	Vertical-MAU																		
25	H	Yes	A	188	Horizontal-MAU	Carrier	50PSH048	12	1600	57.9	5.7	70	2.99	51.4	22	80	67	1.98	19.6	208	3	Nexus - ACH1002	WSHP Open (BACnet)
27	K	Yes	A	104	Horizontal	Carrier	50PSH012	3	335	15.7	4.52	70	1.22	12.7	17.1	80	67	0.74	11.8	120	1	Nexus - ACH0752	WSHP Open (BACnet)
28	J	Yes	A	118	Horizontal	Carrier	50PSH019	4.5	600	22.4	5.2	70	1.33	20.5	20.9	80	67	0.98	10.2	208	1	Nexus - ACH0752	WSHP Open (BACnet)
29	B	No	A	Hall Near 104	Horizontal																		
30	K	Yes	A	118	Horizontal	Carrier	50PSH012	3	335	15.7	4.52	70	1.22	12.7	17.1	80	67	0.74	11.8	120	1	Nexus - ACH0752	WSHP Open (BACnet)
31	K	No	A	Hall Near 114	Horizontal																		
32	K	Yes	A	Vestibule 112	Horizontal	Carrier	50PSH012	3	335	15.7	4.52	70	1.22	12.7	17.1	80	67	0.74	11.8	120	1	Nexus - ACH0752	WSHP Open (BACnet)
33	J	Yes	A	Waiting	Horizontal	Carrier	50PSH019	4.5	600	22.4	5.2	70	1.33	20.5	20.9	80	67	0.98	10.2	208	1	Nexus - ACH0752	WSHP Open (BACnet)
34	K	Yes	A	Kitchen	Horizontal	Carrier	50PSH012	3	335	15.7	4.52	70	1.22	12.7	17.1	80	67	0.74	11.8	120	1	Nexus - ACH0752	WSHP Open (BACnet)
35	J	No	A	Indoor Rec	Horizontal																		
36	L	Yes	B	Basement MR	Vertical	Carrier	50PSV060	15	1695	79.2	5.5	70	4.82	64	19.1	80	67	3.36	23.6	208	3	Nexus - ACH1002	WSHP Open (BACnet)
37	L	Yes	B	Basement MR	Vertical	Carrier	50PSV060	15	1695	79.2	5.5	70	4.82	64	19.1	80	67	3.36	23.6	208	3	Nexus - ACH1002	WSHP Open (BACnet)
38	L	Yes	B	Basement MR	Vertical	Carrier	50PSV060	15	1695	79.2	5.5	70	4.82	64	19.1	80	67	3.36	23.6	208	3	Nexus - ACH1002	WSHP Open (BACnet)
39	L	Yes	C	Mezzanine	Vertical	Carrier	50PSV060	15	1695	79.2	5.5	70	4.82	64	19.1	80	67	3.36	23.6	208	3	Nexus - ACH1002	WSHP Open (BACnet)
40	L	Yes	C	Mezzanine	Vertical	Carrier	50PSV060	15	1695	79.2	5.5	70	4.82	64	19.1	80	67	3.36	23.6	208	3	Nexus - ACH1002	WSHP Open (BACnet)

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Madison County - Jail

Heat Pump Replacement Sheet 5

File: Madison County Jail WSHP Updated 12-16-15.vsd
Page: Schedule
Printed: 11/16/2015
Engineer: WJC
Job:

Heat Pump Locations 1st Floor

Heat pump to be replaced and ID Number

Heat pump to remain and ID Number

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Madison County - Veterans

Heat Pump Replacement Sheet 1

File: Veterans WSHP 12-16-15.vsd

Page: Vets 1st Floor

Printed: 11/17/2015

Engineer: WJC

Job:

Heat Pump Locations 2nd Floor

Heat pump to be replaced and ID Number

Heat pump to remain and ID Number

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Madison County - Veterans

Heat Pump Replacement Sheet 2

File: Veterans WSHP 12-16-15.vsd

Page: Vets 2nd Floor

Printed: 11/17/2015

Engineer: WJC

Job:

						Replacement Heat Pumps				Heating Performance				Cooling Performance					Electrical				
Drawing ID #	Unit Tag	Replace	Floor	Room	Type	Manuf.	Model	Water Flow GPM	CFM	Heating Capacity (MBH)	COP	EAT db F	Power Input kW	Cooling (MBH)	EER	EAT db F	EAT wb F	Power Input kW	FLA	Voltage	PH	Hose Kit	Controller
0	4	Yes	1	Hall near 127	Horizontal	Carrier	50PSH036	9	1200	46.4	5.8	70	2.34	37.8	20.1	80	67	1.49	22	208	1	Nexus - ACH1002	WSHP Open (BACnet)
1	2	No	1	Hall near 116	Horizontal																		
2	4	Yes	1	121	Horizontal	Carrier	50PSH036	9	1200	46.4	5.8	70	2.34	37.8	20.1	80	67	1.49	22	208	1	Nexus - ACH1002	WSHP Open (BACnet)
3	2	No	1	Hall near 113	Horizontal																		
4	2	No	1	Hall near 112	Horizontal																		
5	3	Yes	1	Mens BR	Horizontal	Carrier	50PSH030	7.5	1000	33.8	5.7	70	1.73	30.4	20.7	80	67	1.23	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
6	5	Yes	1	Lobby	Horizontal	Carrier	50PSH042	10.5	1400	47.8	6	70	2.32	44.8	23.8	80	67	1.62	22.7	208	1	Nexus - ACH1002	WSHP Open (BACnet)
7	4	Yes	1	Womens BR	Horizontal	Carrier	50PSH036	9	1200	46.4	5.8	70	2.34	37.8	20.1	80	67	1.49	22	208	1	Nexus - ACH1002	WSHP Open (BACnet)
8	1	Yes	1	Hall near 144	Horizontal	Carrier	50PSH019	4.5	600	22.4	5.2	70	1.33	20.5	20.9	80	67	0.98	10.2	208	1	Nexus - ACH0752	WSHP Open (BACnet)
9	2	Yes	1	Hall near 143	Horizontal	Carrier	50PSH024	6	800	31.4	5.4	70	1.72	27.5	22.3	80	67	1.08	16.3	208	1	Nexus - ACH0752	WSHP Open (BACnet)
10	3	No	1	Hall near 140	Horizontal																		
11	3	Yes	2	Hall near 219	Horizontal	Carrier	50PSH030	7.5	1000	33.8	5.7	70	1.73	30.4	20.7	80	67	1.23	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
12	3	Yes	2	Hall near 215	Horizontal	Carrier	50PSH030	7.5	1000	33.8	5.7	70	1.73	30.4	20.7	80	67	1.23	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
13	3	Yes	2	Lounge	Horizontal	Carrier	50PSH030	7.5	1000	33.8	5.7	70	1.73	30.4	20.7	80	67	1.23	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)
14	2	Yes	2	Hall near 211	Horizontal	Carrier	50PSH024	6	800	31.4	5.4	70	1.72	27.5	22.3	80	67	1.08	16.3	208	1	Nexus - ACH0752	WSHP Open (BACnet)
15	3	No	2	Hall near 207	Horizontal																		
16	1	Yes	2	Observation Room	Horizontal	Carrier	50PSH019	4.5	600	22.4	5.2	70	1.33	20.5	20.9	80	67	0.98	10.2	208	1	Nexus - ACH0752	WSHP Open (BACnet)
17	2	Yes	2	241	Horizontal	Carrier	50PSH024	6	800	31.4	5.4	70	1.72	27.5	22.3	80	67	1.08	16.3	208	1	Nexus - ACH0752	WSHP Open (BACnet)
18	4	Yes	2	241	Horizontal	Carrier	50PSH036	9	1200	46.4	5.8	70	2.34	37.8	20.1	80	67	1.49	22	208	1	Nexus - ACH1002	WSHP Open (BACnet)
19	1	Yes	2	Hall near 230	Horizontal	Carrier	50PSH019	4.5	600	22.4	5.2	70	1.33	20.5	20.9	80	67	0.98	10.2	208	1	Nexus - ACH0752	WSHP Open (BACnet)
20	5	Yes	2	Hall near 228	Horizontal	Carrier	50PSH042	10.5	1400	47.8	6	70	2.32	44.8	23.8	80	67	1.62	22.7	208	1	Nexus - ACH1002	WSHP Open (BACnet)
21	3	Yes	2	Hall near 222	Horizontal	Carrier	50PSH030	7.5	1000	33.8	5.7	70	1.73	30.4	20.7	80	67	1.23	16.9	208	1	Nexus - ACH1002	WSHP Open (BACnet)

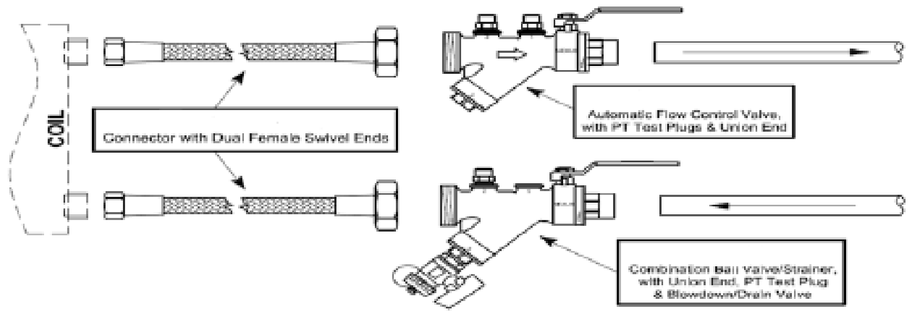
Replacement Heat Pumps Summary						
Bldg	Unit Tag	Number of Units to be Replaced	Voltage	Phase	Manuf.	Model
Vet	1	3	208	1	Carrier	50PSH019
Vet	2	3	208	1	Carrier	50PSH024
Vet	3	5	208	1	Carrier	50PSH030
Vet	4	4	208	1	Carrier	50PSH036
Vet	5	2	208	1	Carrier	50PSH042
Total		17				

Stainless Steel Hose Kit

AHC** 1/2" to 2" Stainless Steel Braided Hose Kit –** Hose kit with a manual shut off valve, auto flow regulator to maintain set GPM and Y strainer for hard water applications. Automatic balancing valves provide a constant flow rate; if the pressure changes (ex. Additional heat pumps) each flow control valve will adjust to the conditions. The Y strainer can filter water with high mineral content which can cause damage over time to equipment.

Specifications:

- Designed for water source heat pump applications.
- Kevlar® reinforced EPDM hose core with stainless steel hose braid
- Swivel connection with dual female ends provides union between heat pump and piping system.
- Brass OT58 fittings
- Ball valve with integral P/T (pressure/temperature) ports and union end



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Madison County - Veterans

Heat Pump Replacement
Sheet 3

File: Veterans WSHP 12-16-15.vsd
Page: Schedule
Printed: 11/17/2015
Engineer: WJC
Job:

Mechanical/Electrical Scope of Work

SmartWatt will provide for turnkey installation of WSHPs:

- Provide engineering stamped drawings for complete installation
- Remove and demolish the existing WSHPs
- Purchase and install replacement WSHPs
- Install all WSHP accessories as indicated in the Schedule
- Install all electrical wiring to make operational
- Provide factory start-up, testing and adjustment of the new system.
- Instruct owner's designated operators on the operation and maintenance of the new equipment

SmartWatt will install variable frequency drives and premium efficiency inverter duty motors on the two (2) WSHP loop pumps. Motors are 10 HP.

- Mount and wire new VFD drives. Bypass existing pump contactor wiring.
- Remove the existing 10 HP motors.
- Replace the existing 10 HP motors with premium efficient inverter duty motors.

Cut sheets for the equipment to be installed is included in Appendix C.

Controls Scope of Work

- The WSHPs will include a controller with a BACNET communications interface. The WSHPs system will be integrated with the existing Metasys EMS system. In addition, the JCI head end will be upgraded to Facility Explorer by JCI included a web based server.
- Existing controllers in the DSS, Jail, and Veterans building will be upgraded as summarized in the table below:

Building	Controls Upgrade
DSS	Add 46 new WSHPs (24 points per WSHP) to EMS
DSS	Replace unit controllers on 5 WSHPs to remain with new BACNET controllers and migrate points to EMS
DSS	Replace 1 existing LOOP controller with BACNET controller and migrate points to new web server.
Jail	Add 33 new WSHPs (24 points per WSHP) to EMS
Jail	Replace unit controllers on 6 WSHPs to remain with new BACNET controllers and migrate points to EMS
Jail	Replace 1 existing LOOP controller with BACNET controller and migrate points to new web server.
Jail	Migrate 7 Controllers for 23 existing exhaust fans to new Web Server. Existing unit controls to be replaced with new BACnet Controllers
Jail	Migrate 1 Controllers for 1 existing Isolation Room unit to new Web Server. Existing unit controls to be replaced with new BACnet Controllers
Veterans	Add 17 new WSHPs (24 points per WSHP) to EMS
Veterans	Replace unit controllers on 5 WSHPs to remain with new BACNET controllers and migrate points to EMS
Veterans	Replace 1 existing LOOP controller with BACNET controller and migrate points to new web server.

Savings Summary

Savings for this FIM are associated with energy conservation as well as reduced repair and replacement costs. Energy savings for this FIM are accomplished through an increase in cooling and heating efficiency of the new WSHP as compared to the existing units. A building simulation was conducted for each facility using Carrier Hourly Analysis Program (HAP) V4.90 to determine the baseline energy usage for the WSHPs. A spreadsheet savings model was developed and is presented in Appendix B. Existing efficiencies ratings were based on manufacturers specifications and are summarized in Table12. Efficiency ratings of the proposed equipment is provided in the schedules on the last page of each drawing set in the pages above.

In addition, pumping power at the Jail (DSS and Veterans buildings already have VFDs on the transfer pumps) will be reduced by installing Variable Frequency Drives on the loop transfer pumps. Savings for the installation of a VFD were calculated using a spreadsheet model. The use of a variable speed drive will allow the pumps to modulate speed depending on system load. Energy savings are associated with a reduction in the power consumed by the pumps.

Energy savings were based on a motor load profile and pump laws in which the power of the motor decreases as a cubic function of the speed. A factor of 2.5 was used rather than 3 to ensure the savings estimates are conservative. The minimum VFD speed is limited at 60% to ensure proper operation of the system and to prevent damage to the motor. The calculations are provided in Appendix B utilizing a BIN temperature analysis as described below:

$$Energy\ Savings\ \left(\frac{kWh}{yr}\right) = Current\ Usage - Proposed\ Usage$$

$$Current\ Usage = \sum_{bin\ hours} Input\ Power\ (kW) x\ Bin\ Hours$$

$$Proposed\ Usage = \sum_{bin\ hours} \frac{Input\ Power\ (kW) x\ VFD\ Flow\ \%_{per\ bin}^{2.5}\ x\ Bin\ Hours}{VFD\ Efficiency}$$

Repair and replacement savings are associated with the reduction in annual costs for replacing WSHPs as they fail. Calculations were performed to estimate failure rates based on historic data obtained from the County. A heat pump failure rate was determined based on the age of the heat pumps. Table 13 summarizes the failure rates and replacement savings for each of the buildings. The per unit replacement cost avoided is estimated at $5,000 per unit and is escalated at 3% per year.

Table 13 – WSHP Failure Rate and Replacement Cost Summary

				Projected Failures Per Year					
Facility	**Total # WSHPs**	**Units Previously Replaced**	**Original Installation Year**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
DSS	51	7	1995	4	5	6	8	10	11
Jail	39	6	1985/1994	5	7	9	12	0	0
Veterans	22	7	1988	3	4	5	3	0	0
Total	**112**	**20**		**12**	**16**	**20**	**23**	**10**	**11**
Avoided Replacement Cost				**$60,000**	**$82,400**	**$106,000**	**$125,350**	**$56,000**	**$63,250**

Baseline Usage and Cost

The energy baseline for this FIM is defined as the existing energy usage for cooling and heating. The usage and cost are at the energy rates provided in Table 6.

Facility	Electrical Consumption (kWh/yr)	Electrical Annual Cost ($/yr)	Natural Gas Consumption (therm/yr)	Natural Gas Annual Cost ($/yr)	Total Annual Cost
DSS WSHPs	198,424	$17,858	5,129	$4,401	$22,259
Jail WSHPs	352,286	$31,353	19,286	$15,101	$46,454
Jail Transfer Pumps	54,762	$4,874	-	-	$4,874
Veterans WSHPs	103,923	$9,977	10,481	$8,563	$18,540
Total	709,395	$64,062	34,896	$28,065	$92,127

Post Retrofit Energy Use and Cost

The projected energy use and cost for this FIM are shown in the table below.

Facility	Electrical Consumption (kWh/yr)	Electrical Annual Cost ($/yr)	Natural Gas Consumption (therm/yr)	Natural Gas Annual Cost ($/yr)	Total Annual Cost
DSS WSHPs	137,648	$12,388	4,931	$4,231	$16,619
Jail WSHPs	238,613	$21,237	18,250	$14,290	$35,527
Jail Transfer Pumps	16,203	$1,442	-	-	$1,442
Veterans WSHPs	73,821	$7,087	9,797	$8,004	$15,091
Total	466,285	$42,154	32,978	$26,525	$68,679

The energy savings are the difference between the Baseline and the Post Retrofit energy use and cost multiplied by a safety factor of 0.9 as summarized in the table that follows.

Facility	Electrical Consumption (kWh/yr)	Electrical Annual Cost ($/yr)	Natural Gas Consumption (therm/yr)	Natural Gas Annual Cost ($/yr)	Total Annual Savings
DSS WSHPs	54,699	$4,923	178	$153	$5,076
Jail WSHPs	102,306	$9,104	932	$730	$9,834
Jail Transfer Pumps	34,703	$3,089	-	-	$3,089
Veterans WSHPs	27,092	$2,601	616	$503	$3,104
Total	218,800	$19,718	1,726	$1,386	$21,103

Annual savings associated with equipment failure vary by year as shown in Table 13.

Utility Incentives

SmartWatt will apply for incentives through National Grid's energy efficiency program. SmartWatt anticipates an incentive of $32,893 for this FIM.

FIM #3: Building Envelope Improvements

Annual Cost Savings	Implementation Cost	Incentive/Rebate
$7,819	$108,743	$14,851

Facilities Affected

This FIM will be completed in the following facilities:

- County Office Building
- Veterans Building
- DSS
- Public Health
- Jail
- Highway Department (Wampsville)

Observation

A detailed review of each of the above buildings was conducted by a building envelope specialist from ECP Building Envelope Specialists, Inc. Several areas with significant infiltration were discovered as described in the scope below.

Recommendation

This measure incorporates a number of strategies designed to reduce infiltration of the building envelope. The scope of work for each building is provided below:

County Office Building

5 Single commercial doors to be weather-stripped (4 to receive dark bronze anodized weather-stripping)

2 Double commercial doors to be weather-stripped (1 to receive dark bronze anodized weather-stripping)

3 Roof top ventilators to be opened, dampers lubricated and perimeters sealed, 20 linear feet

595’ Window/floor joint to be re-caulked at 2nd floor building perimeter. Existing caulking must be tested for lead, asbestos and PCBs prior to removal. Project cost excludes abatement if required.

Veterans Building

4 Single commercial doors to be weather-stripped (3 to receive dark bronze anodized weather-stripping)

1 Double commercial doors to be weather-stripped (1 to receive dark bronze anodized weather-stripping)

8 Roof top ventilators to be opened, dampers lubricated and perimeters sealed, 32 linear feet

87’ Soffit joint to be sealed at first floor connection to second floor overhang

173’ Roof/wall joint to be sealed at interior (hallway connector to court house)

DSS

3 Single commercial doors to be weather-stripped

2 Double commercial doors to be weather-stripped

2 Roof top ventilators to be opened, dampers lubricated and perimeters sealed, 8 linear feet

614’ Roof/wall joint and soffit joint to be sealed at 2nd floor perimeter

Public Health

4 Single commercial doors to be weather-stripped (1 to receive dark bronze anodized weather-stripping)

4 Roof top ventilators to be opened, dampers lubricated and perimeters sealed, 36 linear feet

14’ Exterior caulking above main “store front” entry

650 Square feet of 1” Dow Thermax Sheathing to be installed to exterior steel stud wall framing above drop tile ceilings on first and second floors.

Jail/PSB

12 Single commercial doors to be weather-stripped (7 in Jail area)

2 Single commercial interior doors to be weather-stripped (sally port entries)

1 Double commercial door to be weather-stripped

4 Exterior closet/plumbing chase access doors to be weather-stripped

8 Overhead garage doors to be weather-stripped, 328 linear feet

6 Roof top ventilators to be opened, dampers lubricated and perimeters sealed, 32 linear feet (administration areas only)

345’ Roof/wall joint to be sealed (administration areas and County Sheriff’s sally port)

Highway Department (Wampsville Garage)

7 Single commercial doors to be weather-stripped

7 Roll-up garage doors to be weather-stripped, 448 linear feet

Highway Department (Wampsville Office)

1 Single commercial door to have gaskets replaced with like

The following materials have been specified for use in the weatherization of Madison County. Cut sheets for these materials are provided in Appendix C.

Single/Double Door Weather-Stripping

- ECP Aluminum Door Carrier (QDS 650 Retainer) (mill finish and dark bronze anodized)
- Schlegel QLON-QDS 650 Polyethylene Clad Urethane Foam Gasket
- Schlegel QLON-QFS 375 Polyethylene Clad Urethane Foam Gasket w/ adhesive backer
- 3M Super 77 Multipurpose Spray Adhesive
- Schlegel Door Sweep with Fin Seal
- DAP Alex Plus Acrylic Latex Caulk Plus Silicone (clear)

Overhead/Roll-Up Garage Door Weather-Stripping

- Sealeze Nylon Brush Weather-Seal with EPDM Fin Seal Gasket
- Action Industries Aluminum Bottom Overhead Door Retainer ("T" Rubber Retainer)
- Action Industries Bottom "T" Rubber Seal
- Action Industries Rolling Steel Bottom Seal (Roll-Up Garage Door)
- DAP Alex Plus Acrylic Latex Caulk plus Silicone (clear)

Roof Top Ventilator Sealing

- WD40
- DAP All Purpose Indoor/Outdoor Silicone
- Convenience Products Touch'nSeal All-season 1-component Foam

Roof/Wall Joint and Soffit Joint Air-Sealing

- Convenience Products Touch'nSeal CPDS 750FR (2 part foam)
- Dow Thermax Sheathing FSK (1/2", 1") (used as insulated backer for joint spans larger than 4")

Exterior Caulking

- Sikaflex Construction Sealant

Window Caulking (COB)

- Sikaflex Construction Sealant

Savings Summary

Based on the results of the envelope inspection an infiltration (leakage rate) was determined for the items to be corrected. By reducing infiltration the rate of heat transfer is reduced, resulting in energy savings. To estimate energy savings a spreadsheet model was developed to determine the leakage rate, heating energy savings, and cooling energy savings. The spreadsheet model results are presented in Appendix B.

Baseline Usage and Cost

The energy baseline for this FIM is defined as the existing crack area for infiltration and the associated energy wasted for the affected HVAC systems as shown in the table below. The baseline electric and natural gas rates in Table 6 are applied.

Crack Area (ft^2)	Electrical Consumption (kWh/yr)	Electrical Annual Cost ($/yr)	Natural Gas Consumption (therm/yr)	Natural Gas Annual Cost ($/yr)	Total Annual Cost
51.7	7,923	$715	8,860	$7,104	$7,819

Post Retrofit Energy Use and Cost

The post retrofit conditions assume that the total crack area will be sealed and the energy losses will be reduced to zero.

The savings are the difference between the Baseline and the Post Retrofit energy use and cost multiplied by a safety factor of 1.0 as summarized in the table that follows.

Guaranteed Electrical Consumption Savings (kWh/yr)	Guaranteed Electrical Annual Cost Savings ($/yr)	Guaranteed Natural Gas Consumption Savings (therm/yr)	Guaranteed Natural Gas Annual Cost Savings ($/yr)	Guaranteed Total Annual Cost Saving ($/yr)
7,923	$715	8,860	$7,104	$7,819

Utility Incentives

SmartWatt will apply for incentives through National Grid's energy efficiency program. SmartWatt anticipates an incentive of $14,851 for this FIM.

FIM #4: Energy Management System (EMS) Upgrades

Annual Cost Savings	Implementation Cost	Incentive/Rebate
$8,882	$127,611	$21,885

Facilities Affected

This FIM will be completed in the following facilities:

- County Office Building
- Veterans Building
- DSS
- Public Health
- Courthouse

Observation

Currently the County has a Johnson Controls Metasys system to provide control of HVAC equipment at the buildings indicated above. Data loggers were deployed during the IGA throughout the County facilities in the project to determine the operating characteristics of the buildings HVAC systems. These included temperature sensors as well as equipment operating hours. In general, the EMS is providing a fairly tight temperature control band and night setback was widely used were appropriate.

Two areas for improvement in the EMS were observed:

1. Building startup and shutdown scheduling
2. Turning off AHU/FCU fans during unoccupied hours

Recommendation

Table 14 provides a summary of the energy savings controls strategies that will be implemented.

Table 14 – EMS Upgrades Summary by Building

Facility	Optimal Start/Stop	Reduce Fan Operating Hours
County Office Building	✓	✓
Veterans Building	✓	
DSS	✓	
Public Health	✓	✓
Courthouse	✓	

Optimal Start/Stop

SmartWatt will provide for Optimal Start/Stop controls at the buildings indicated in Table 14. Optimal Start/Stop control algorithms start and stop HVAC equipment at variable times based on calculations that determine the optimal use of the system. Start and stop times of equipment will depend upon the

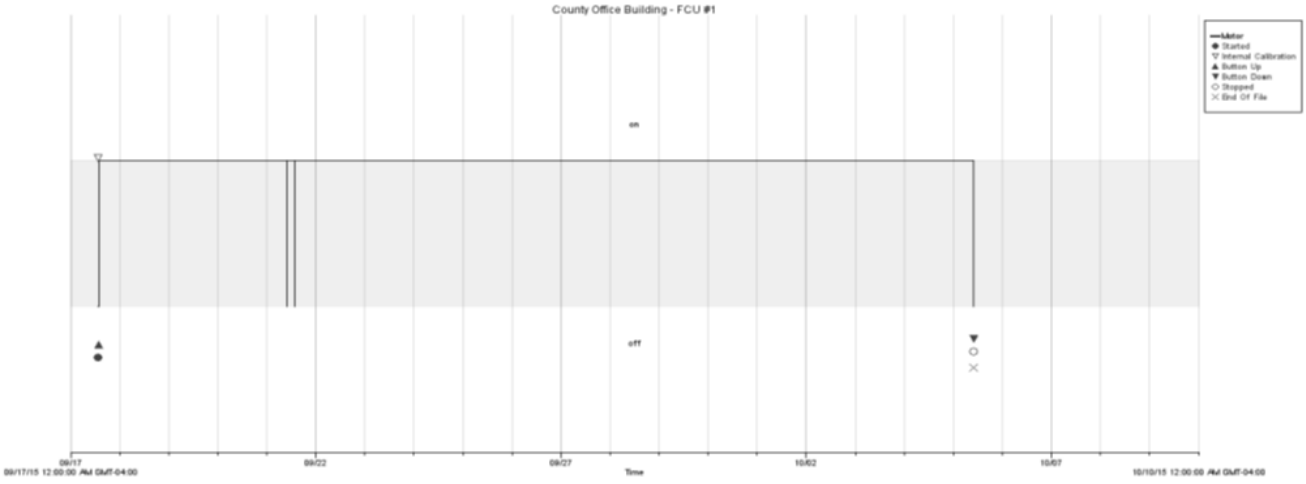
outside and inside temperatures of the building, occupancy state, expected occupancy times, and temperature and ventilation set points.

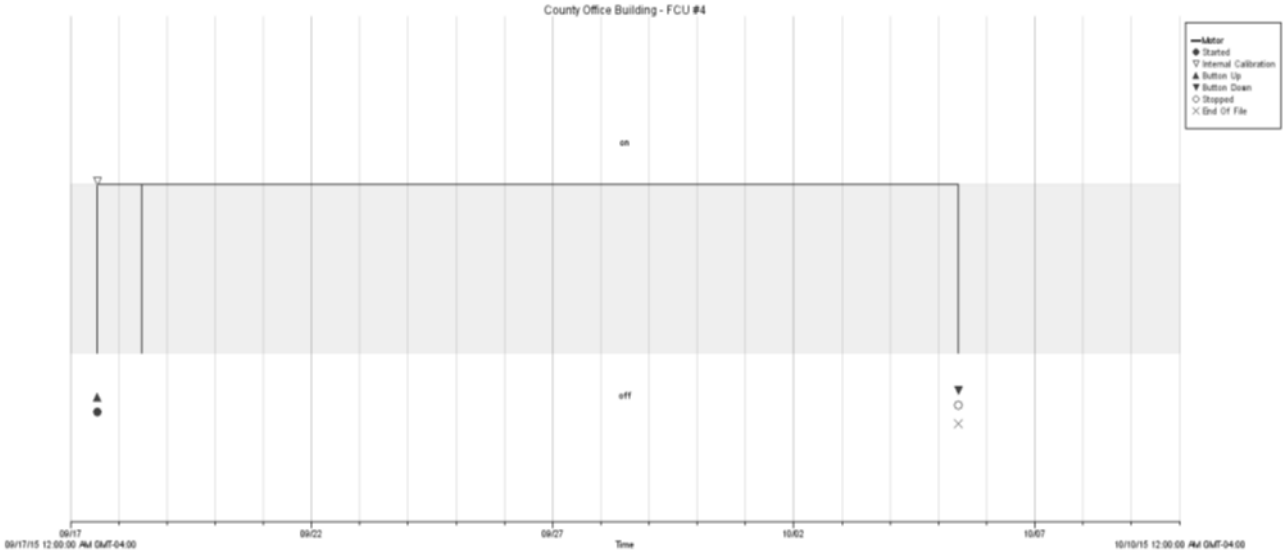
Optimal start will start the units prior to occupancy, but no earlier than necessary to have the space conditions satisfied at occupancy. Optimal stop will stop the unit as much as an hour before the beginning of an unoccupied period if the program predicts the space will maintain conditions through occupancy. Savings are achieved through a reduction in the operating time of HVAC equipment.

Reduce Fan Operating Hours

Data loggers were deployed on Air Handling Units (AHUs) and Fan Coil Units (FCUs) at the County Office Building and the Public Health Building. At the County Office Building, FCUs 1 and 4 were observed to be operating continuously as shown in Figure 9. Each of the FCUs has a 7.5 HP fan motor. The charts show the FCUs ran nearly continuously over the two week period they were logged.

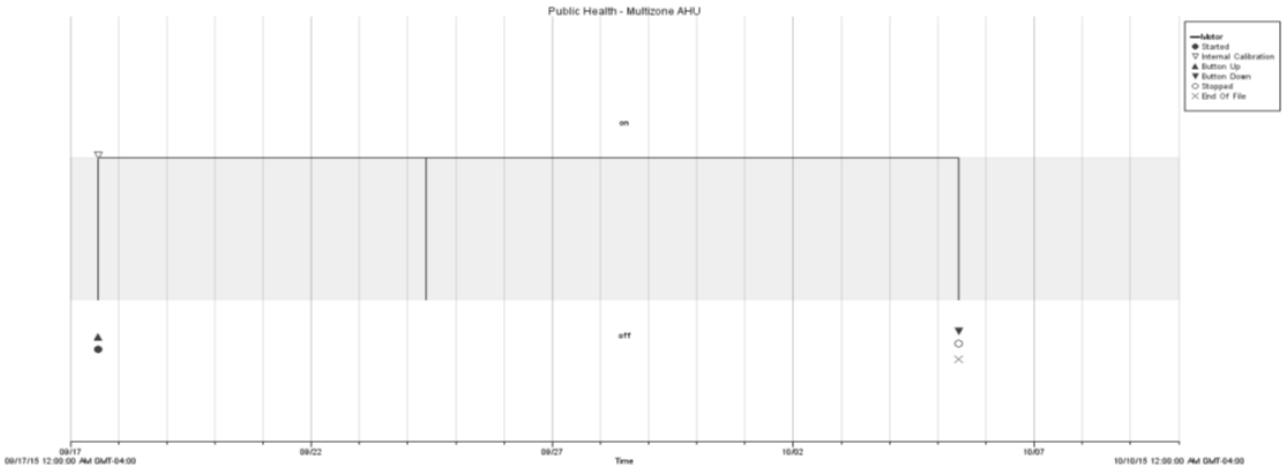
Figure 9 – County Office Building FCU Operating Hours





At the Public Health building the15 HP multizone AHU supply fan was observed to be running continuously as shown in Figure 10.

Figure 10 – Public Health Building AHU Operating Hours



Savings Summary

Savings for this FIM are accomplished through two controls improvements:

- Optimal Start/Stop programming at the County Office Building
- AHU/FCU fan operating hours reduction

Optimal Start/Stop

Savings are based on a reduction in the warm-up time required for each building and the resulting reduction in the cooling and heating loads for the affected buildings. The use of an optimal start/stop algorithm will allow a higher level of setback during the heating season and setup during the cooling

season during the unoccupied periods. A spreadsheet cooling and heating simulation was developed and is presented in Appendix B. In addition, for buildings with AHU/FCUs a reduction in fan power was calculated based on the reduced operating hours.

Reduce Fan Operating Hours

Savings for this measure were calculated using a spreadsheet model. Energy savings were based on a reduction in operating hours as described in the equations below and provided in Appendix B.

$$Energy\ Savings\ \left(\frac{kWh}{yr}\right) = Current\ Usage - Proposed\ Usage$$

$$Current\ Usage = HP\ x\ Load\ Factor\ x\ 0.746\frac{kW}{HP}x\ Current\ Run\ Hours\ \div Motor\ Efficiency$$

$$Proposed\ Usage = HP\ x\ Load\ Factor\ x\ 0.746\frac{kW}{HP}x\ Proposed\ Run\ Hours\ \div Motor\ Efficiency$$

The current operating hours are based on continuous operating (168 hours/week). The proposed motor operating hours are based on 12 hours/day usage Monday to Friday with a 20% cycling factor during the unoccupied period (81.6 hours/week).

Baseline Usage and Cost

The energy baseline for this FIM is defined as the existing energy usage for the affected buildings as shown in the table below.

Building	Electrical Consumption (kWh/yr)	Electrical Annual Cost ($/yr)	Natural Gas Consumption (therm/yr)	Natural Gas Annual Cost ($/yr)	Total Annual Cost
County Office Building	1,531,617	$140,623	48,628	$36,543	$177,166
Veterans Building	270,880	$26,662	11,080	$7,996	$34,658
DSS	732,000	$67,412	5,829	$5,001	$72,413
Public Health	Included in County Office Building				
Courthouse	Included in County Office Building				
Total	2,534,497	$234,697	65,537	$49,540	$284,237

Post Retrofit Energy Use and Cost

The projected energy use and cost for this FIM are shown in the table below.

Building	Electrical Consumption (kWh/yr)	Electrical Annual Cost ($/yr)	Natural Gas Consumption (therm/yr)	Natural Gas Annual Cost ($/yr)	Total Annual Cost
County Office Building	1,434,049	$131,842	48,080	$36,132	$167,973
Veterans Building	270,880	$26,662	10,823	$7,786	$34,448
DSS	732,000	$67,412	5,285	$4,534	$71,946
Public Health	Included in County Office Building				
Courthouse	Included in County Office Building				
Total	2,436,929	$225,916	64,188	$48,452	$274,368

The savings are the difference between the Baseline and the Post Retrofit energy use and cost multiplied by a safety factor of 0.9 as summarized in the table that follows.

Guaranteed Electrical Consumption Savings (kWh/yr)	Guaranteed Electrical Annual Cost Savings ($/yr)	Guaranteed Natural Gas Consumption Savings (therm/yr)	Guaranteed Natural Gas Annual Cost Savings ($/yr)	Guaranteed Total Annual Cost Saving ($/yr)
87,811	$7,903	1,214	$979	$8,882

Utility Incentives

SmartWatt will apply for incentives through National Grid's energy efficiency program. SmartWatt anticipates an incentive of $21,885 for this FIM.

FIM #5: Install ECM Motors in Walk-in Coolers/Freezers

Annual Cost Savings	Implementation Cost	Incentive/Rebate
$549	$1,880	$940

Facilities Affected
This FIM will be completed in the Jail.

Observation
The Jail kitchen area has 2 walk-in coolers and 2 walk-in freerzers. Each of the coolers has one 1/15 HP evaperator fan motor. The freezers each have two 1/15 HP evaperator fans. Thus, there are a total of six (6) evaperator fans. The existing motors are shaded pole (SP) motors.

Recommendation
SmartWatt will replacing the existing shaded pole motors with electronically commutated motors (ECMs) as described in the table below.

Table 15 – ECM Motor Summary

Location	Existing Motor	Total # of Motors	Proposed ECM Motor
Jail Cooler 1	1/15HP SP	1	Arktic 59 1/15th HP ECM 115/120V
Jail Cooler 2	1/15HP SP	1	Arktic 59 1/15th HP ECM 115/120V
Jail Freezer 1	1/15HP SP	2	Arktic 59 1/15th HP ECM 115/120V
Jail Freezer 2	1/15HP SP	2	Arktic 59 1/15th HP ECM 115/120V

Savings Summary
Savings associated with replacing the existing evaporator motors is estimated based on the improved motor efficiencies, which consume less energy along with the complementary savings on the refrigeration system from imposing less of a load on the compressor. ECM motors use about 50% less energy than shaded pole motors for refrigeration purposes. In addition to being more efficient, these motors also reduce the load on the system because of the reduction in heat imposed on the refrigeration system. The calculations are provided in Appendix B.

Baseline Usage and Cost
The energy baseline for this FIM is defined as the existing annual electric energy usage of the fans and the additional load of the SP motors on the refrigeration system at a rate $0.089/kWh as shown in the table below.

Electrical Consumption (kWh/yr)	Electrical Annual Cost ($/yr)
9,267	$825

Post Retrofit Energy Use and Cost

The projected energy use and cost for this FIM are shown in the table below.

Electrical Consumption (kWh/yr)	Electrical Annual Cost ($/yr)
2,418	$215

The savings are the difference between the Baseline and the Post Retrofit energy use and cost multiplied by a safety factor of 0.9 as summarized in the table that follows.

Guaranteed Electrical Consumption Savings (kWh/yr)	Guaranteed Electrical Annual Cost Savings ($/yr)
6,165	$549

Utility Incentives

SmartWatt will apply for incentives through National Grid's energy efficiency program. SmartWatt anticipates an incentive of $940 for this FIM.

FIM #6: Replace Boilers in Jail

Annual Cost Savings	Implementation Cost	Incentive/Rebate
$22,953	$206,280	$6,000

Facilities Affected
This FIM will be completed in the Jail.

Observation
The Jail is heated through the use of water source heat pumps. Heating to the water loop is provided by three non-condensing boilers. The boiler plant consists of two (2) Precision Model G300 (240 MBH) boilers with a combustion efficiency of about 80% and one (1) Patterson-Kelley Thermific boiler with an output of 1,020 MBH and a combustion efficiency of 85%. The boilers are at or beyond their expected useful lives.

Figure 11 –Jail Boilers (Precision)

Recommendation
SmartWatt will remove and replace the existing three natural gas-fired boilers that feed the WSHP loop. The three boilers will be removed and replaced with two (2) 750 MBH Patterson Kelley Mach Series condensing hot water boilers. SmartWatt will provide a turnkey replacement of the boilers including connection with the existing JCI EMS. Cut sheets for the new boiler are provided in Appendix C.

Mechanical/Electrical Scope of Work

- Remove and demolish the existing boilers
- Install two (2) Patterson-Kelley Mach Series 750 MBH boilers – Model CM750
- Install all boiler manufacturer accessories including temperature wells and temperature sensors
- Install all electrical wiring to make operational
- Modify/replace housekeeping pad as required for new boiler installation
- Provide for proper venting of boiler exhaust and provide manufacturers approved termination
- Provide PVC or single walled metal duct from combustion air inlet of boilers to the exterior wall, terminating with a screened weather proof intake hood
- Strictly follow all manufactures installation recommendations
- Install condensate neutralization kit and PVC pipe to the nearest drain
- Existing transfer pumps to remain in service
- Provide as-built drawings
- Provide factory start-up, testing and adjustment of the new system. Instruct owner's designated operators on the operation and maintenance of the new equipment

Controls Scope of Work

The new boiler will be provided with a BACNET communications interface. The existing N2 legacy Metasys controller is not BACNET compatible and will be replaced with a new Metasys BACNET compatible controller.

Savings Summary

Savings associated with replacing the boiler is through increased combustion efficiency of the units. The current boilers have a combustion efficiency of about 82.5% and an overall efficiency[1] of about 70.1%. The proposed boiler has a combustion efficiency range of 89-99% depending on if the boiler is in condensing mode (primarily a factor of return water temperature). For this facility, the average post installation combustion efficiency was estimated to be 94% and the overall efficiency at 84.6%. The savings were calculated by applying the increase in efficiency to the baseline natural gas usage for space heating as shown in the equations below. The DHW natural gas usage was estimated by annualizing the natural gas use for the non-heating months.

$$Annual\ NG\ Savings = Baseline\ NG\ Use - Proposed\ NG\ Use$$

$$Baseline\ NG\ Use = 19{,}286\ therm/yr$$

$$Proposed\ NG\ Use = \frac{Current\ Heat\ Output}{Proposed\ Efficiency} = \frac{19{,}286\ x\ 0.701}{0.846} = 15{,}986\ therm/yr$$

$$Annual\ NG\ Savings = 19{,}286 - 15{,}986 = 3{,}300\ therm/yr$$

Repair and replacement savings are associated with the reduction in annual costs for replacing the boilers as they fail. The replacement savings was distributed over ten years at a cost of $20,628 per year and is escalated at 3% per year.

Baseline Usage and Cost

The energy baseline for this FIM is defined as the existing energy usage for the hot water boiler at a rate of $0.78/therm as shown in the table below.

Natural Gas Consumption (therm/yr)	Natural Gas Annual Cost ($/yr)
19,286	$15,101

[1] The overall efficiency is the product of the combustion efficiency and other boiler losses including distribution losses, shell losses, and cycling losses.

Post Retrofit Energy Use and Cost

The projected energy use and cost for this FIM are shown in the table below.

Natural Gas Consumption (therm/yr)	Natural Gas Annual Cost ($/yr)
15,986	$12,517

The savings are the difference between the Baseline and the Post Retrofit energy use and cost multiplied by a safety factor of 0.9 as summarized in the table that follows.

Guaranteed Natural Gas Consumption Savings (therm/yr)	Guaranteed Natural Gas Annual Cost Savings ($/yr)
2,970	$2,325

Utility Incentives

SmartWatt will apply for incentives through National Grid's energy efficiency program. SmartWatt anticipates an incentive of $6,000 for this FIM.

FIM #7: Install New Domestic Hot Water Heater at the Jail

Annual Cost Savings	Implementation Cost	Incentive/Rebate
$12,468	$113,273	$2,400

Facilities Affected

This FIM will be completed in the Jail.

Observation

The current DHW system at the Jail includes two natural gas-fired AO Smith Model HW-300 hot water heaters. The units have an output rating of 240 MBH and a combustion efficiency of 82%.

Figure 12 – Jail Domestic Hot Water System

Recommendation

SmartWatt will remove the two direct hot water heaters and install two new Intellihot 251 MBH wall mounted condensing direct domestic hot water heaters. The new units will be plumbed to provide all of the domestic hot water needs for the facility. Cut sheets for the new hot water heaters are provided in Appendix C.

Mechanical/Electrical Scope of Work

- Remove and demolish the existing hot water heaters
- Install two (2) Intellihot iQ251 hot water heaters
- New units will be installed in the same area as the existing AO Smith hot water heaters
- Install all hot water heater manufacturer accessories including temperature wells and temperature sensors
- Install all electrical wiring to make operational
- Provide and install necessary mounting to hang the units on the wall nearest the existing units
- Provide CPVC venting from each hot water heater using approved termination.
- Provide PVC or single walled metal duct from combustion air inlet of heaters to the exterior wall, terminating with a screened weather proof intake hood
- Install condensate neutralization kit and PVC pipe to the nearest drain
- Existing transfer pumps to remain in service
- Provide as-built drawings
- Provide factory start-up, testing and adjustment of the new system. Instruct owner's designated operators on the operation and maintenance of the new equipment

Controls Scope of Work

The new domestic hot water heaters will be provided with a BACNET communications interface. SmartWatt will integrate the controls of the unit with the JCI EMS.

Savings Summary

Savings associated with installing the condensing replacing the boiler is through increased combustion efficiency of the units as compared to using the existing non-condensing units that have a combustion efficiency of about 82%. The proposed domestic hot water heaters have an efficiency of about 96%. Because this facility also uses natural gas for space heating and kitchen use, it is not possible to determine the baseline use by meter. A detailed water assessment was conducted at the Jail to determine the portion of the annual water that is heated. The table below shows a summary of the baseline water usage and natural gas cost to make hot water at the site:

Water Survey Consumption Results		
Current Total Water Consumption	3,200	CCF/ yr
Current Total Water Consumption	2,394	kGal[2]/ yr
Toilets	976	kGal/ yr
Urinals	165	kGal/ yr
Sinks	62	kGal/ yr
Showers	425	kGal/ yr
Kitchen, Laundry, Others	766	kGal/ yr
DHW Consumption of heated water	1,173	kGal/ yr
Baseline Domestic Hot Water Consumption and NG Usage		
Baseline DHW Consumption	1,173	kGal/ yr
Hot water temperature stored in tanks	140	F
Average cold water inlet temperature	47	F
Current boiler efficiency	82%	
Current DHW Energy Input - NG	11,096	therm/yr
Current DHW Annual Cost	8,688	$/yr

For this facility, the average post installation efficiency is estimated to be 96%. The savings are calculated by applying the increase in efficiency to the baseline natural gas usage for the generation of domestic hot water as shown in the table below:

Proposed Domestic Hot Water Consumption and NG Usage		
Proposed domestic hot water efficiency	96%	
Proposed DHW Energy Input - NG	9,478	therm/yr
Proposed DHW Annual Cost	7,421	$/yr
Annual Savings		
Annual NG Usage Reduction	1,618	therm/yr

[2] KGal = 1,000 gallons

Repair and replacement savings are associated with the reduction in annual costs for replacing the domestic hot water heaters as they fail. The replacement savings was distributed over ten years at a cost of $11,327 per year and is escalated at 3% per year.

Baseline Usage and Cost

The energy baseline for this FIM is defined as the existing energy usage for the generation of domestic hot water at a rate of $0.783/therm as shown in the table below.

Natural Gas Consumption (therm/yr)	Natural Gas Annual Cost ($/yr)
11,096	$8,688

Post Retrofit Energy Use and Cost

The projected energy use and cost for this FIM are shown in the table below.

Natural Gas Consumption (therm/yr)	Natural Gas Annual Cost ($/yr)
9,478	$7,421

The savings are the difference between the Baseline and the Post Retrofit energy use and cost multiplied by a safety factor of 0.9 as summarized in the table that follows.

Guaranteed Natural Gas Consumption Savings (therm/yr)	Guaranteed Natural Gas Annual Cost Savings ($/yr)
1,456	$1,140

Utility Incentives

SmartWatt will apply for incentives through National Grid's energy efficiency program. SmartWatt anticipates an incentive of $2,400 for this FIM.

FIM #8: Install Window Tinting at County Office Building

Annual Cost Savings	Implementation Cost	Incentive/Rebate
$8,628	$125,894	$18,332

Facilities Affected

This FIM will be completed in the County Office Building

Observation

The County Office Building has double pane windows that comprise the majority of wall space(total of 8,466 ft^2) throughout much of the building. The windows are double pane aluminum frame units without a thermal break and have an existing U-value of about 0.64. The windows, although aesthetically pleasing, are a large source of solar gain resulting in overheating and excessive glare particularly during the summer months. During the winter months the windows provide a large heat transfer surface resulting in heat loss and higher space heating loads. To address these issues the County has installed vertical blinds. The blinds do block a portion of the solar gain and reduce glare but they also greatly limit the view. In addition, the windows have space heating and cooling air diffusers in the bottom sill and the blinds disrupt the pattern of flow resulting in a loss of energy.

Figure 13 – County Office Building Windows and Blinds

Recommendation

SmartWatt will install 8,556 ft^2 of EnerLogic VEP35 (Eastman Chemical Company) window tinting. Each face of the building will be tinted with the exception of the connecting corridor between the County Office Building and the Courthouse. This corridor has several different window colors and installing tinting will result in a displeasing appearance.

The selected window tinting has several advantages:

- Reduction in solar gain during summer months
- Reflects radiant heat back into the building during heating months
- Reduces glare
- Blocks Ultraviolet (UV) rays
- Allow blinds to be left open or removed

The tinting will be applied to all of the glass panels on all faces of the building with the exception of doors. During the IGA, a mock up installation was installed on the first floor on the upper portion of the window near the historic records area on the west wall. The outdoor air temperature at the time of installation was about 20°F. Within minutes of installation the glass temperature had increased by 10°F illustrating the ability of the tinting to reflect heat. Product data sheets and details of the 15 year warranty are provided in Appendix C.

Savings Summary

To estimate energy savings a spreadsheet model was developed to calculate the cooling load increase associated with solar gain and the heat loss associated with the existing windows. The spreadsheet uses average daily transmitted solar radiation from the National Renewable Energy Laboratory (NREL) for the Syracuse area. Based on this solar radiation data the cooling gain was determined for the existing conditions and for the post retrofit conditions based on a 56% reduction in solar heat rejection. Savings for the heating season are determined by a BIN analysis to calculate the existing and proposed heat loss based on a reduction in window U value from 0.64 to 0.33 Btu/hr-ft^2-F). The calculation is provided in Appendix B.

Baseline Usage and Cost

The energy baseline for this FIM is defined as the existing energy loss for cooling and heating for the windows that will have film installed at a rate of $0.090/kWh and $0.751/therm as shown in the table below.

Electrical Consumption (kWh/yr)	Electrical Annual Cost ($/yr)	Natural Gas Consumption (therm/yr)	Natural Gas Annual Cost ($/yr)	Total Annual Cost
83,434	$7,509	12,159	$9,131	$16,640

Post Retrofit Energy Use and Cost

The projected energy use and cost for this FIM are shown in the table below.

Electrical Consumption (kWh/yr)	Electrical Annual Cost ($/yr)	Natural Gas Consumption (therm/yr)	Natural Gas Annual Cost ($/yr)	Total Annual Cost
36,710	$3,304	6,269	$4,708	$8,012

The savings are the difference between the Baseline and the Post Retrofit energy use and cost as summarized in the table that follows.

Guaranteed Electrical Consumption Savings (kWh/yr)	Guaranteed Electrical Annual Cost Savings ($/yr)	Guaranteed Natural Gas Consumption Savings (therm/yr)	Guaranteed Natural Gas Annual Cost Savings ($/yr)	Guaranteed Total Annual Cost Saving ($/yr)
46,723	$4,205	5,889	$4,423	$8,628

Utility Incentives

SmartWatt will apply for incentives through National Grid's energy efficiency program. SmartWatt anticipates an incentive of $18,332 for this FIM.

FIM #9: Replace Transformers

Annual Cost Savings	Implementation Cost	Incentive/Rebate
$2,381	$48,673	$3,316

Facilities Affected

This FIM will be completed in the following facilities:

- County Office Building
- Veterans Building

Figure 14 – Transformer Loss Test

Observation

During the IGA, County owned transformers were evaluated for replacement at the buildings listed above and the Courthouse. A total of 10 transformers were evaluated and their losses determined for the load the transformers typically operate. The three transformers evaluated at the Courthouse were removed from consideration due to uncertain future changes at that facility.

Recommendation

SmartWatt will replace seven (7) of the existing transformers that are not owned by the electric utility with premium efficiency transformers. Table 16 describes the location of the transformers to be replaced, their location, and size. During the IGA, each of the transformers was labeled. The tag number for each of the transformers is included in the table that follows.

Table 16 –Transformer Replacement Summary

Tag Number	Building	Location	Transformer Name	Size (kVA)
40003	County Office Building	2nd Floor Electrical Room	LV5	30
40004	County Office Building	Basement Mechanical Room	TE1	30
40006	County Office Building	Basement Mechanical Room	HV1	45
40005	County Office Building	Basement Mechanical Room	T1	45
40007	County Office Building	Woman's Bathroom 1st Floor	T2	45
40008	County Office Building	Treasurer's Office 2nd Floor	T3	30
40009	Veterans Building	Main Electric Room Basement	EMG	30

The transformers listed above will be replaced with Powersmith model E-Saver 2016-R K=rated transformers of the same size as the existing units. Cut sheets for the transformers to be installed are included in Appendix C.

Savings Summary

Savings for this measure are associated with a reduction in losses. During the IGA, a loss study was conducted by Powersmith and a baseline determined for each of the transformers to be replaced. A "Transformer Baseline Measurement Report" is included in Appendix E and detailed calculations shown in Appendix B. The table below summarizes the efficiency gains for each of the transformers to be replaced.

Tag Number	Building Name	Size (kVA)	Number of Units	Baseline Efficiency (Occupied Hours)	Baseline Efficiency (Unoccupied Hours)	Proposed Efficiency (Occupied Hours)	Proposed Efficiency Unoccupied Hours)
40003	COB	30	1	93.8%	87.2%	98.2%	97.6%
40004	COB	30	1	93.8%	87.2%	98.2%	97.6%
40006	COB	45	1	90.6%	82.1%	97.9%	96.3%
40005	COB	45	1	90.6%	82.1%	97.9%	96.3%
40007	COB	45	1	90.6%	82.1%	97.9%	96.3%
40008	COB	30	1	93.8%	87.2%	98.2%	97.6%
40009	Veterans	30	1	93.8%	87.2%	98.2%	97.6%

Baseline Usage and Cost

The energy baseline for this FIM is defined as the existing transformer losses at the building rates shown in Table 6 as shown in the table below.

Electrical Consumption (kWh/yr)	Electrical Annual Cost ($/yr)
34,809	$3,157

Post Retrofit Energy Use and Cost

The projected transformer energy losses and cost for this FIM are shown in the table below.

Electrical Consumption (kWh/yr)	Electrical Annual Cost ($/yr)
7,178	$651

The savings are the difference between the Baseline and the Post Retrofit energy use and cost multiplied by a safety factor of 0.95 as summarized in the table that follows.

Guaranteed Electrical Consumption Savings (kWh/yr)	Guaranteed Electrical Annual Cost Savings ($/yr)
26,249	$2,381

Utility Incentives

SmartWatt will apply for incentives through National Grid's energy efficiency program. SmartWatt anticipates an incentive of $3,316 for this FIM.

5.0 Measurement & Verification Plan

5.1 M&V Plan Overview

The purpose of the Measurement and Verification (M&V) Plan is to identify the methods, measurements, and procedures and tools that will be used to verify the Savings for each FIM. Savings are determined by comparing baseline usage and cost against the post FIM implementation usage and costs. The Baseline usage of all facilities is described in Section 3.3 of this IGA report.

Measurement and verification of energy savings will be based on the International Performance Measurement and Verification Protocol (IPMVP) Option A - Retrofit Isolation: Key Parameter Measurement. This plan was developed by William Clark, Certified Measurement & Verification Professional (CMVP).

Option A as defined by IPMVP, Volume I, 2012 is provided below:

Option A - Retrofit Isolation: Key Parameter Measurement. Savings are determined by field measurement of the key performance parameter(s) which define the energy use of the FIMs affected system(s) and/or the success of the Project. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the measured parameter and the length of the reporting period. Parameters not selected for field measurement are estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter is required. The plausible savings error arising from estimation rather than measurement is evaluated.

The following table summarizes the Year 1 energy savings expected from this project as estimated by SmartWatt.

Table 17 - Year 1 Total Energy Savings

	Annual Consumption Before	Annual Consumption After	Usage Savings	Annual Cost Savings
Electricity	3,569,710 kWh	2,652,729 kWh	916,981 kWh	$83,965
Natural gas	127,033 therm	104,917 therm	22,116 therm	$17,358
Total				$101,323

The energy/water reduction, Year 1 utility cost savings, and O&M savings for each FIM is summarized in Table 18.

Table 18 - Year 1 Energy Usage Savings by FIM

FIM	Electric Usage Savings (kWh/yr)	Year 1 Electric Cost Savings ($/yr)	Natural Gas Usage Savings (therm/yr)	Year 1 Natural Gas Cost Savings ($/yr)	Year 1 Total Energy Cost Savings ($/yr)
1 - Lighting Upgrades	523,310	$48,495	0	$0	$48,495
2 - Replace Water Source Heat Pumps	218,800	$19,718	1,726	$1,386	$21,103
3 - Building Envelope Improvements	7,923	$715	8,860	$7,104	$7,819
4 - EMS Upgrades	87,811	$7,903	1,214	$979	$8,882
5 - Install ECM Motors	6,165	$549	0	$0	$549
6 - Replace Boilers in Jail	0	$0	2,970	$2,325	$2,325
7 - Install DHW Heaters in Jail	0	$0	1,456	$1,140	$1,140
8 - Window Tinting at County Office Bldg	46,723	$4,205	5,889	$4,423	$8,628
9 - Replace Transformers	26,249	$2,381	0	$0	$2,381
Total	916,981	$83,965	22,116	$17,358	$101,323

Guaranteed Energy Savings

Upon agreement of the UESC project, SmartWatt will provide an Measurement & Verification Service Contract to the County. As per that contract, SmartWatt will guarantees that during the Term, the County will achieve the following Annual Measured and Verified Utility Unit Savings:

Electric Energy Savings	916,981 kWh/Yr
Natural Gas	22,116 therm /Yr

The savings will be presented to the County in the form of an annual energy savings guarantee reconciliation report ("Savings Reconciliation Report") each year within the Term. The report will be due within 90 days of the end of each year in the term. The first report will be due one year and 90 days after the Services Commencement Date, which coincides with the end of the implementation period.

Repair and Replacement Savings

The table below identifies the annual Repair and Replacement Savings for each year of the 17 year term. The Repair & Replacement savings are associated with the annual material replacement savings associated with replacing the existing lighting with long-life LED lighting and avoided replacement costs associated with WSHPs, Jail boilers, and the Jail domestic hot water heaters. The savings are based on calculated equipment failure and repair expenditures and will be stipulated. Annual savings are provided in Table 19. This stipulated Repair & Replacement savings will not be measured or verified during the term.

Annual Cost Savings

The annual savings for each year of the term applying the applicable escalation rates is provided in Table 19. The energy cost savings are calculated by multiplying the energy and water usage savings by the baseline rates described in Section 3.2 and presented in Table 24. The savings guarantee does not operate to guarantee the savings per FIM. Rather, the calculation of savings is based on aggregate

performance of all of the FIMs contained in the project. Annual energy (excluding electric supply rate savings) and water savings are escalated using the following annual escalation factors:

Electric Energy Savings Escalation Rate	3.18%
Natural Gas Energy Savings Escalation Rate	4.44%

Table 19 - Annual Cost Saving for Contract Term

Annual Period	Guaranteed Utility Cost Savings	Stipulated Repair & Replacement Cost Savings	Total Savings
Year 1	$101,323	$104,280	$205,603
Year 2	$104,763	$128,008	$232,772
Year 3	$108,323	$152,948	$261,271
Year 4	$112,006	$173,649	$285,655
Year 5	$115,817	$105,662	$221,479
Year 6	$119,761	$114,286	$234,047
Year 7	$123,841	$52,424	$176,264
Year 8	$128,063	$53,824	$181,887
Year 9	$132,432	$55,237	$187,669
Year 10	$136,953	$56,664	$193,617
Year 11	$141,631	$16,563	$158,194
Year 12	$146,473	$17,060	$163,533
Year 13	$151,483	$17,572	$169,055
Year 14	$156,669	$18,099	$174,768
Year 15	$162,035	$18,642	$180,678
Year 16	$167,590	$19,202	$186,791
Year 17	$173,339	$19,778	$193,117

5.2 Baseline: Energy and Operating Conditions

Baseline Period

The baseline period is calendar year 2014 (January 1, 2014 – December 31, 2014).

Baseline Utility Consumption

Twelve months of utility data for calendar year 2014 were compiled for electricity and natural gas for the buildings in the project. A monthly presentation of the baseline utility data is provided in Appendix A and summarized in Table 20. Note that the County Office Building, Courthouse, and the Public Health building are served by the same utility meters and no sub metering is available.

Table 20 – Baseline Utility Usage Summary

Facility	Electric Usage (kWh/yr)	Natural Gas Usage (therm/yr)
County Office Building/ Courthouse/ Public Health	1,531,617	48,628
Veterans Building	270,880	11,080
Facilities Maintenance Garage	12,194	2,399
DSS	732,000	5,828
Jail	851,400	32,525
Hwy Department (Wampsville)	171,619	26,573
Total	3,569,710	127,033

Baseline Utility Rates

The utility rates presented in Table 21 are the current rates for distribution and supply of utilities at the time of this agreement and shall be used to calculate savings associated with the reduction of electricity, natural gas, and water/sewer into cost savings in Year 1. After year 1, these stipulated utility rates shall be increased by the utility escalation rates described in Section 5.1 of this M&V plan to calculate the savings in each subsequent year after Year 1.

Table 21 - Baseline Utility Rates

Building	Electricity Distribution ($/kWh)	Electricity Supply ($/kWh)	Electricity Total ($/kWh)
County Office Building	$0.032	$0.058	$0.090
Veterans Building	$0.039	$0.058	$0.096
Facilities Maintenance Garage	$0.032	$0.058	$0.090
DSS	$0.032	$0.058	$0.090
Courthouse	$0.032	$0.058	$0.090
Public Health	$0.032	$0.058	$0.090
Jail	$0.031	$0.058	$0.089
Hwy Department (Wampsville)	$0.082	$0.058	$0.140

Building	NG Distribution ($/therm)	NG Supply ($/therm)	NG Total ($/therm)
County Office Building	$0.177	$0.574	$0.751
Veterans Building	$0.243	$0.574	$0.817
Facilities Maintenance Garage	$0.395	$0.574	$0.969
DSS	$0.284	$0.574	$0.858
Courthouse	$0.177	$0.574	$0.751

Public Health	$0.177	$0.574	$0.751
Jail	$0.209	$0.574	$0.783
Hwy Department (Wampsville)	$0.395	$0.574	$0.810

Baseline Operating Conditions

Baseline operating conditions provide a summary of the building use, equipment and operating modes during the baseline period. No significant changes are expected related to these conditions; however, if a change occurs in these conditions, the baseline energy usage may be adjusted (permanently or temporarily).

Table 22 –Baseline Operating Conditions

Building	Address	Square Footage	Weekday Operating Schedule	Weekend Operating Schedule
County Office Building	138 N Court Street, Wampsville, NY	54,180	8 AM - 6 PM	Closed
Veterans Building	138 N Court Street, Wampsville, NY	24,200	8 AM - 6 PM	Closed
Facilities Maintenance Garage	138 N Court Street, Wampsville, NY	5,000	7:30 AM - 4 PM	Closed
DSS	133 N Court Street, Wampsville, NY	47,882	7:30 AM - 6 PM	Closed
Courthouse	138 N Court Street, Wampsville, NY	34,020	8 AM - 6 PM	Closed
Public Health	138 N Court Street, Wampsville, NY	15,244	8 AM - 5 PM	Closed
Jail	138 N Court Street, Wampsville, NY	55,440	24 hour/day	24 hour/day
Hwy Department (Wampsville)	5 Donald Hicks Dew Drive, Wampsville, NY	38,798	7 AM - 5 PM	Closed (Except for Winter Plowing)

Independent Variables

Independent variables include factors that can affect the facility's energy consumption. The largest independent variable is typically weather. For example, an abnormally cold winter will result in additional heating and natural gas consumption. A safety factor has been applied to the calculations to minimize the affect of abnormal weather conditions but if a change occurs outside the range of the safety factor, the baseline energy usage may be adjusted for that particular heating or cooling season.

For electricity and natural gas consumption, the relevant independent variable is average monthly outside air temperature. The average outside air temperature for the baseline period and 30 year Bin

data (Bin Maker Pro) is provided in Table 23. The source of the baseline data is the weather station at Griffis Airport in Rome, NY.

Table 23 - Baseline Period Outside Air Temperature

Period		Baseline Average Outside Air Temperature (°F)	30 Year Bin Temperature Data (°F)
From	To		
1/1/2014	1/31/2014	17	24.5
2/1/2014	2/28/2014	18	29.2
3/1/2014	3/31/2014	24	32.4
4/1/2014	4/30/2014	44	43.8
5/1/2014	5/31/2014	58	58.7
6/1/2014	6/30/2014	66	66.1
7/1/2014	7/31/2014	68	69.0
8/1/2014	8/31/2014	67	65.9
9/1/2014	9/30/2014	61	62.1
10/1/2014	10/31/2014	53	50.4
11/1/2014	11/30/2014	36	39.6
12/1/2014	12/31/2014	31	24.4

5.3 M&V Plan Measurements Summary and Costs

To minimize annual costs of the M&V program discussions were held with the County to determine the appropriate level of M&V service that ensures savings goals are being met in an economically prudent fashion. The first annual performance period begins on the date of substantial completion of the project. Annual M&V reports will be provided within 30 days of the end of each annual performance period. Section 5.5 provides detailed information on the M&V procedures for each measure. Table 24 provides an overview of the key parameters to be analyzed and their frequency. The M&V schedule is broken down into three frequency types:

1. First Year Measurements - to be completed in the first M&V period only
2. Annual Measurements – to be completed each year after the first year (Years 2, 3, 4,… 17)

Table 24 - M&V Key Parameters and Frequency

Facility Improvement Measure	Key Parameter	First Year	Annual
1 - Lighting Upgrades	Fixture Power	Yes	No
2 - Replace Water Source Heat Pumps	WSHP Power	Yes	Yes
3 - Building Envelope Improvements	Visual Inspection	Yes	No
4 - EMS Upgrades: Optimal Start/Stop	Space Temperature, Outside Air Damper Position, Supply Fan Status	Yes	Yes
4 - EMS Upgrades: Reduce Fan Operating Hours	Fan Operating Hours	Yes	Yes
5 - Install ECM Motors	Motor Power	Yes	No
6 - Replace Boilers in Jail	Combustion Efficiency	Yes	Yes
7 - Install DHW Heaters in Jail	Combustion Efficiency	Yes	Yes
8 - Window Tinting at County Office Bldg	Visual Inspection	Yes	No
9 - Replace Transformers	Transformer Power Losses	Yes	No

Table 25 summarizes the annual M&V costs for each year of the project term. As described in the table above, certain measures (Lighting, Building Envelope Improvements, ECM Motors, Window Tinting, and Transformers) will be assessed in the Year 1 report only. These items have high certainty that once installed they will continue to offer the savings projected and additional M&V efforts after Year 1 is not a good use of the County's spending.

Table 25 - Annual M&V Costs

Annual Period	Annual M&V Cost	Annual Period	Annual M&V Costs
Year 1	$6,326	Year 10	$2,860
Year 2	$2,258	Year 11	$2,946
Year 3	$2,326	Year 12	$3,034
Year 4	$2,395	Year 13	$3,125
Year 5	$2,467	Year 14	$3,219
Year 6	$2,541	Year 15	$3,316
Year 7	$2,617	Year 16	$3,415
Year 8	$2,696	Year 17	$3,518
Year 9	$2,777		

5.4 M&V Method by FIM

FIM-1: Lighting Upgrades

SmartWatt will replace the existing T12 and T8 lighting with LED lighting technology equipped with occupancy controls. In addition, SmartWatt will replace the existing HID exterior lighting with LED lighting. SmartWatt will furnish and install lighting and occupancy sensors to automatically shut the lights off in certain identified areas.

M&V Option

Option A was selected to provide a cost effective means to evaluate savings.

Overview of M&V Activities

M&V for this FIM will be performed in Year 1 ONLY. The key parameter to be measured will be power draw of a representative sample for baseline and post-implementation fixtures.

Pre-FIM Measurements

1. Count of existing fixture types (Appendix D)
2. Fixture wattage for a representative sample
3. Lighting operating hours by space type
4. Occupancy hours for select areas that will include occupancy sensors

The table below summarizes the lighting operating hours by space type based on the results of data loggers which measure the hours the lights are on as well as the hours the space is occupied. The Jail/PSB building has unique operating hours and the usage groups for this facility are shown separately. These same hours will be used for the post installation savings calculation.

Table 26 - Lighting Operating Hours by Space Type

Usage Group	Hours / Year	Usage Group	Hours / Year
Offices	2,311	Jail Inmate Areas	4,474
Cubicle Office Space	3,825	Jail Restrooms	4,567
Corridors	2,743	Jail Nightlights	2,738
Conference Rooms	2,000	Jail Corridors	8,760
Break Rooms	2,072	Jail/PSB Break rooms	3,788
Courtrooms	1,558	PSB Offices	1,506
Garages	2,607	PSB Corridors	4,911
Library	2,241	PSB Restrooms/Locker Rooms	4,567
Restrooms	1,365		
Storage/Janitorial Closets	217		
Exterior Lighting	4,380		

The following table presents the results of the occupancy sensors and includes the percent reduction in operating hours by space type.

Table 27 - Occupancy Sensor Hours Reduction Factor

Usage Group	% Reduction
Offices	30%
Cubicle Office Space	20%
Break Rooms	30%
Conference Rooms	27%
Wampsville Hwy Garage	30%
Library	97%
Restrooms	30%

Post-FIM Measurements

1. Count of each fixture type
2. Identification and documentation of each fixture type
3. Fixture wattage for a representative sample
4. Visual inspection of all units in year 1 and verification of wattage rating by referencing specification sheets for each fixture type

Sample Size for Power Measurements. Pre and Post-FIM power will be measured once at the fixture level by fixture types that make up the majority of the energy savings. Four fixture types account for 47% of the total energy savings. Estimated sample sizes for these fixture types assuming a coefficient of variation (Cv) of 0.5, 20% Precision, and 80% Confidence are shown in the table that follows.

Table 28 - Lighting M&V Fixture Sample Size

Fixture Type	Quantity	Sample Size
RB/2LED/L	527	10
RB/3LED/L	1066	10
RB2LED N-JAIL	310	10
RKTF/2LED/N	176	10
Total	2,079	40

Stipulated Parameters

1. Hours of operation for exterior lighting shall be 4,380 hours per year (dusk to dawn)
2. Closets operating hours = 217 hr/yr based on interviews with building staff
3. Occupancy sensor reductions in areas not metered conservatively estimated at 30%.

Savings Calculation Method

To calculate energy and cost savings for all interior lighting FIMs, the following equations shall be used.

$$Baseline\ KW\ =\ ((Fixture\ Count\ *\ Fixture\ Wattages)/1000)$$
$$Baseline\ kWh\ =\ (Baseline\ KW\ *Operating\ Hours\ of\ Operation)$$
$$Post\ Install\ KW\ =\ ((Fixture\ Count\ *\ Fixture\ Wattages)/1000)$$

$$Post\ Install\ kWh\ =\ (Post\ Install\ KW\ *\ Hours\ of\ Operation)$$
$$kWh\ Savings\ =\ (Baseline\ kWh\ -\ Post\ Install\ kWh)$$
$$Cost\ Savings\ =\ (kWh\ Savings\ *\ \frac{\$}{kWh}\ Rate)$$

FIM-2: Replace Water Source Heat Pumps

SmartWatt will install new Carrier Water Source Heat Pumps (WSHP) to replace the existing units that are at their end of life. In addition, SmartWatt will install variable frequency drives on the two 10 HP WSHP loop transfer pumps in the Jail (the transfer pumps in DSS and Veterans already have VFDs).

M&V Option

Option A was selected to provide a cost effective means to evaluate savings.

Overview of M&V Activities

M&V for this FIM will be performed in each year of the project term. The key parameter to be measured will be energy usage of the heat pumps recorded for a one-week period and compared to the equipment efficiency used in the energy model. The key parameter to be measured for the Jail transfer pumps will be motor power and outside air temperature. Motor power will be recorded for a one-week period.

Pre-FIM Measurements

1. Annual natural gas and electricity consumption
2. Existing WSHP inventory
3. Existing WSHP COP and EERs
4. Motor operating hours

Post-FIM Measurements

1. Energy usage of 5 of the WSHP units for a one-week period
2. Outside air temperature
3. Visual inspection of all units in year 1 and verification of nameplate efficiencies (EER and COP)
4. Motor power draw for a one week period in 10 second intervals
5. Outside air temperature for the same one week period in 1 minute intervals

Stipulated Parameters

Stipulated parameters were based on current equipment nameplates, drawings, and a building energy simulation was conducted using Carrier Hourly Analysis Program (HAP) V4.90. A summary of the results of the HAP building simulation and key stipulated parameters is provided in the table that follows.

DSS	
Baseline HVAC Related Natural Gas Usage (HAP simulation)	5,129 therm/yr
Baseline HVAC Related Electricity Usage (HAP simulation)	198,424 kWh/yr
Boiler Efficiency	92.0%
Total Cooling Capacity	1,547 MBH

Total Heating Capacity	1,763 MBH
Adjusted Cooling Hours	1,391
Adjusted Heating Hours	357
Existing and Proposed EER and COP	Varies, see table in Appendix B

Jail/PSB	
Baseline HVAC Related Natural Gas Usage (HAP simulation)	19,286 therm/yr
Baseline HVAC Related Electricity Usage (HAP simulation)	352,286 kWh/yr
Boiler Efficiency	92.0%
Total Cooling Capacity	1,547 MBH
Total Heating Capacity	1,763 MBH
Adjusted Cooling Hours	1,391
Adjusted Heating Hours	357
Existing and Proposed EER and COP	Varies, see table in Appendix B
Motor Horsepower per WSHP Transfer Pump	10 HP
Current Motor Efficiency	90%
Minimum VFD Speed Limit	60%
BIN Temperature Data	Utica, NY

Veterans Building	
Baseline HVAC Related Natural Gas Usage (HAP simulation)	10,481 therm/yr
Baseline HVAC Related Electricity Usage (HAP simulation)	103,923 kWh/yr
Boiler Efficiency	92.0%
Total Cooling Capacity	1,547 MBH
Total Heating Capacity	1,763 MBH
Adjusted Cooling Hours	1,391
Adjusted Heating Hours	357
Existing and Proposed EER and COP	Varies, see table in Appendix B

Savings Calculation Method

Energy savings for the WSHPs are calculated by increasing the cooling and heating efficiency as compared to the existing WSHPs. The baseline electricity and natural gas usage were determined utilizing a HAP building model. The key parameters to be measured will be kW for a sample of 5 WSHPs each year by selecting a random mix each year. Savings will be determined by subtracting post-retrofit annual consumption, as calculated using the energy engineering model provided in Appendix B. The heat pump savings will be determined based on comparing the nameplate efficiency (EER and COP) to the measured kW of the installed units. The calculations utilized to determine savings are provided below:

$$Annual\ NG\ Savings = Baseleine\ WSHP\ Loop\ NG\ Use - Post\ Installation\ WSHP\ Loop\ NG\ Use$$

WSHP Loop NG Use = WSHP Heating Output x 0.75[3] *÷ 100 ÷Boiler Efficiency*

$$Annual\ Electric\ Savings = Baseline\ Electric\ WSHP\ Use - Post\ Electric\ WSHP\ Use$$

$$Electric\ WSHP\ Use = WSHP\ Cooling\ Use + WSHP\ Heating\ Use$$

$$WSHP\ Cooling\ Use = Cooling\ MBH \times Cooling\ Hours \div EER$$

$$WSHP\ Heating\ Use = Heating\ MBH\ x\ Heating\ Hours \div COP \div 3.412$$

$$EER = \frac{Rated\ Btu\ of\ Cooling\ Tons}{Measured\ Watt\ hours}$$

$$COP = \frac{Rated\ Btu\ of\ Heating}{Measured\ Watt\ hours}$$

$$Annual\ \$\ Savings\ =\ Annual\ NG\ Savings\ \times \frac{\$}{Therm} Rate + Annual\ kWh\ Savings \times \frac{\$}{kWh} Rate$$

Energy savings for the Jail WSHP loop transfer pumps were based on a motor load profile and pump laws in which the power of the motor decreases as a cubic function of the speed. A factor of 2.5 was used rather than 3 to ensure the savings estimates are conservative. The minimum VFD speed is limited at 60% to ensure proper operation of the system and to prevent damage to the motor. The calculations used to determine savings are presented below. The power draw of the motors and outside air temperatures for the same period will be logged and verified in the BIN temperature analysis presented in Appendix B and described below:

$$Energy\ Savings\ \left(\frac{kWh}{yr}\right) = Current\ Usage - Post\ Implementation\ Usage$$

$$Current\ Usage = \sum_{bin\ hours} Input\ Power\ (kW) x\ Bin\ Hours$$

$$Proposed\ Usage = \sum_{bin\ hours} Metered\ Input\ Power$$

$$Cost\ Savings\ =\ (kWh\ Savings\ *\ \frac{\$}{kWh}\ Rate)$$

FIM-3: Building Envelope Improvements

SmartWatt will seal building cracks and gaps as described in FIM-3 to reduce building infiltration.

M&V Option

Option A was selected to provide a cost effective means to evaluate savings.

[3] Assumes that 75% of the heat produced comes from the boilers and 25% comes from heat generated by the WSHP (compressor, motors, friction …).

Overview of M&V Activities

M&V for this FIM will be performed in Year 1 ONLY. A visual inspection will be performed to ensure the scope of work items as described in the FIM-3 description in Section 4 of this IGA report were completed. No further annual M&V will be performed.

Pre-FIM Measurements

1. Size of cracks at doors and gaps in buildings
2. Space temperature setpoints

Post-FIM Measurements

1. Visual inspection of doors and gaps to ensure cracks are eliminated

Stipulated Parameters

Stipulated parameters were based on current equipment nameplates, drawings, and engineering estimates as defined in the table that follows for each building.

Building Envelope Upgrades	
% Infiltration to Exfiltration	50%
Wind Velocity	7.9 mph
Heating Efficiency	Varies by Building See Appendix B
Cooling Efficiency	Varies by Building See Appendix B
Outside Air Temperature	BIN Maker Plus for Utica, NY
Heating and Cooling Season Hours	BIN Maker Plus for Utica, NY
Supply Air Enthalpy	Psychometric Chart
Outside Air Enthalpy	BIN Maker Plus for Utica, NY
Stack Coefficient	Table in Appendix B
Wind Coefficient	Table in Appendix B
Shielding Class	Table in Appendix B

Savings Calculation Method

Energy savings are calculated with an energy model based on the reduction in infiltration. The calculation is provided in Appendix B.

$$Annual\ Savings = Baseline\ Infiltration\ Energy\ Loss - Post\ Installation\ Energy\ Loss$$

$$Annual\ \$\ Savings\ =\ Annual\ NG\ Savings\ \times \frac{\$}{Therm} Rate + \ Annual\ kWh\ Savings\ \times \frac{\$}{kWh} Rate$$

FIM-4: Energy Management System Upgrades

Completion of this FIM includes the following three upgrades:

- ***County Office Building***

- Reduce operating hours of FCUs 1 and 4.
- Provide for Optimal Start/Stop controls.

- ***Veterans Building***
  - Provide for Optimal Start/Stop controls.
- ***DSS Building***
  - Provide for Optimal Start/Stop controls.
- ***Public Health Building***
  - Reduce operating hours of the Multizone AHU.
  - Provide for Optimal Start/Stop controls.
- ***Courthouse***
  - Provide for Optimal Start/Stop controls.

M&V Option

Option A was selected to provide a cost effective means to evaluate savings while providing periodic reviews to ensure the controls setpoint adjustments remain in effect for the term of the agreement.

Overview of M&V Activities

M&V for this FIM will be performed annually. The two improvement types are described below:

Optimal Start/Stop

The key parameters to be measured will be space temperature and percentage outdoor air damper position trended at one-hour intervals through existing Metasys EMS. Space temperatures will be used to determine the profile of unoccupied period space temperature for each BIN. Outdoor air damper position will be used in conjunction with supply fan status and space temperature to determine when air handlers are in warm-up mode (pre-heating with 100% return air). Electric and natural gas energy savings will be calculated using the pre-retrofit annual baseline cooling and heating consumption established in the IGA and subtracting the post-retrofit annual cooling and heating consumption by the air handler as estimated by running the energy spreadsheet model with the measured values.

Reduce FCU and AHU Operating Hours

The key parameter will be operating hours. Trended data reports will be setup using the existing Metasys EMS. Energy savings will be calculated using the pre-retrofit annual fan consumption established in Appendix B of the IGA and subtracting the post-retrofit annual fan consumption based on the annual operating hours from the EMS trended data report.

Pre-FIM Measurements (Optimal Start/Stop)

1. Heating and cooling setpoints
2. Heating and cooling schedules
3. Space Temperatures

Post-FIM Measurements (Optimal Start/Stop)

1. Trended space temperatures
2. Trended outside air temperatures

3. Outside air damper position

Pre-FIM Measurements (Reduce FCU and AHU Fan Operating Hours)

1. Fan runtime (data loggers – shown to be 24/7)

Post-FIM Measurements (Reduce FCU and AHU Fan Operating Hours)

1. Trended annual operating hours

Stipulated Parameters

An engineering spreadsheet model was developed for each building. The stipulated parameters are provided in Appendix B. were based on current equipment nameplates, drawings, and engineering estimates as defined in the table that follows for each building.

County Office Building	
Total Supply Air Flow (CFM)	32,000
Minimum Outside Air (%)	12
Occupied Temperature Setpoint (°F)	70
Current Building Warm-up Time (hours)	2.5
Fan Power (HP)	37.5
Fan Load Factor (%)	90
Fan Motor Efficiency (%)	90
Average Outside Air During Warm-up	30 year weather data for Utica, NY
FCU 1 Power (HP)	7.5
FCU 4 Power (HP)	7.5
Veterans Building	
Total Supply Air Flow (CFM)	21,900
Minimum Outside Air (%)	20
Occupied Temperature Setpoint (°F)	70
Current Building Warm-up Time (hours)	2.5
Average Outside Air During Warm-up	30 year weather data for Utica, NY
Public Health Building	
Total Supply Air Flow (CFM)	11,075
Minimum Outside Air (%)	20
Occupied Temperature Setpoint (°F)	70
Current Building Warm-up Time (hours)	2.5
Fan Power (HP)	15
Fan Load Factor (%)	90
Fan Motor Efficiency (%)	93
Average Outside Air During Warm-up	30 year weather data for Utica, NY

Courthouse	
Total Supply Air Flow (CFM)	16,000
Minimum Outside Air (%)	20
Occupied Temperature Setpoint (°F)	70
Current Building Warm-up Time (hours)	2.5
Fan Power (HP)	16
Fan Load Factor (%)	90
Fan Motor Efficiency (%)	90
Average Outside Air During Warm-up	30 year weather data for Utica, NY

Savings Calculation Method

Optimal Start/Stop

Bin weather data was used to calculate annual heating and cooling energy used. After initiating the optimal start/stop sequences the warm-up and cool-down times will be reduced when outside air temperatures permit resulting in a decrease in the annual hours of conditioning outdoor air, resulting in heating savings and cooling savings. An energy spreadsheet model was developed and will be used to calculate post implementation savings. The calculations utilized are provided in Appendix B

Reduce FCU and AHU Operating Hours

A BIN data cooling simulation was performed using a spreadsheet analysis with savings based on the decrease in operating hours for the affected fans. The equations used to determine the energy savings are summarized below and the calculation is provided in Appendix B.

$$Energy\ Savings\ \left(\frac{kWh}{yr}\right) = Current\ Usage - Post\ Implementation\ Usage$$

$$Current\ Usage = \frac{Motor\ HP\ x\ Load\ Factor\ x\ 0.746\frac{kW}{HP}\ x\ Current\ OperatingHours}{Motor\ Efficiency}$$

$$Post\ Usage = \frac{Motor\ HP\ x\ Load\ Factor\ x\ 0.746\frac{kW}{HP}\ x\ Measured\ OperatingHours}{Motor\ Efficiency}$$

$$Cost\ Savings\ = (kWh\ Savings\ *\ \frac{\$}{kWh}\ Rate)$$

FIM-5: Install ECM Motors in Walk-In Coolers/Freezers

SmartWatt will install six (6) ECM motors in walk-in coolers and freezers in the Jail kitchen. Each motor is currently 1/15 HP in size.

M&V Option

Option A was selected to provide a cost effective means to evaluate savings.

Overview of M&V Activities

M&V for this FIM will be performed in Year 1 ONLY. The key parameter to be measured will be motor power. Motor power will be recorded for a one-week period.

Pre-FIM Measurements

1. Motor operating hours

Post-FIM Measurements

1. Motor power draw for a one week period in 30 second intervals

Stipulated Parameters

Stipulated parameters were based on current equipment nameplates, drawings, and engineering estimates as defined in the table that follows.

Jail Kitchen Cooler/Freezer Motors	
Motor Horsepower per unit (HP)	1/15
Power draw per motor (kW)	0.136
Compressor power reduction per motor (kWh/yr)	353

Savings Calculation Method

Energy savings were based on a reduction in motor power draw and reduced heat load resulting in coincident compressor load. The calculations used to determine savings are presented below. The power draw of the motors will be logged and verified through the use of the spreadsheet analysis provided in Appendix B and described below:

$$Energy\ Savings\ \left(\frac{kWh}{yr}\right) = Current\ Usage - Post\ Implementation\ Usage$$

$$Current\ Usage = \ Existing\ Motor\ Power\ x\ Operating\ Hours$$

$$Proposed\ Usage = \ Measured\ Motor\ Power\ x\ Operating\ Hours - Compressor\ Energy\ Reduction$$

$$Cost\ Savings\ = \ (kWh\ Savings\ * \frac{\$}{kWh}\ Rate)$$

FIM-6: Replace Boilers in Jail

SmartWatt will replace the three (3) existing natural gas-fired hot water boilers (totaling 1,500) with two 750 MBH Patterson Kelley Mach Series condensing hot water boilers.

M&V Option

Option A was selected to provide a cost effective means to evaluate savings.

Overview of M&V Activities

M&V for this FIM will be performed annually throughout the project term. The key parameter to be measured will be combustion efficiency.

Pre-FIM Measurements

1. Annual natural gas consumption

Post-FIM Measurements

1. Combustion efficiency

Stipulated Parameters

Stipulated parameters were based on current equipment nameplates, drawings, and engineering estimates as defined in the table that follows for each building.

Old Courthouse Boiler	
Current Boiler Combustion Efficiency	82.5%
Current Distribution Efficiency	85.0%
Current Overall System Efficiency (Product of Comb. and Dist. Efficiencies)	70.1%
Current Annual Domestic Hot Water NG Usage	11,096 therm/yr
Increase in Distribution Efficiency Associated with Reduced Cycling	5%

Savings Calculation Method

Energy savings are calculated by increasing boiler efficiency from an average of 78% to 93%. The calculations utilized to determine savings are provided below:

$$Annual\ NG\ Savings = Baseline\ NG\ Use - Post\ Installation\ NG\ Use$$

$$Baseline\ NG\ Use = Total\ Facility\ NG\ Use - DHW\ NG\ Use$$

$$Post\ Install\ NG\ Use = \frac{Baseline\ NG\ Use \times Current\ Boiler\ Efficiency}{Post\ Installation\ Measured\ \ Efficiency\ x\ Post\ Install\ Distribution\ Efficiency}$$

$$Annual\ \$\ Savings\ =\ Annual\ NG\ Savings\ \times\ \$/Therm\ Rate$$

FIM-7: Install New Domestic Hot Water Heaters at Jail

SmartWatt will install two Intellihot 251 MBH condensing Domestic Hot Water (DHW) heaters.

M&V Option

Option A was selected to provide a cost effective means to evaluate savings.

Overview of M&V Activities

M&V for this FIM will be performed annually throughout the term. The key parameter to be measured will be combustion efficiency.

Pre-FIM Measurements

1. Annual natural gas consumption
2. Domestic hot water temperature in storage tanks (140°F)
3. Survey of water consuming equipment

Post-FIM Measurements

1. Combustion efficiency

Stipulated Parameters

Stipulated parameters were based on current equipment nameplates, drawings, and engineering estimates as defined in the table that follows for each building.

PSB/Jail Domestic Hot Water Heater	
Current HW Heater Efficiency (nameplate)	82.0%
Baseline DHW Usage	1,173 kGal/yr
Average Cold Water Inlet Temperature (estimated)	47°F

Savings Calculation Method

Energy savings are calculated by increasing boiler efficiency from an average of 82% to 96%. The calculations utilized to determine savings are provided below:

$$Annual\ NG\ Savings = Baseline\ NG\ Use - Post\ Installation\ NG\ Use$$

$$Baseline\ NG\ Use = \frac{Baseline\ DHW\ Usage\ \times 8.34 \times (T\ DHW - T\ In)}{Boiler\ Efficiency \times 100}$$

$$Post\ Installation\ NG\ Use = \frac{Baseline\ DHW\ Usage\ \times 8.34 \times (T\ DHW - T\ In)}{Measured\ Boiler\ Efficiency \times 100}$$

$$Annual\ \$\ Savings\ =\ Annual\ NG\ Savings\ \times\ \$/Therm\ Rate$$

FIM-8: Install Window Tinting at the County Office Building

SmartWatt will install window tinting on 8,466 square feet of windows in the County Office Building.

M&V Option

Option A was selected to provide a cost effective means to evaluate savings.

Overview of M&V Activities

M&V for this FIM will be performed in Year 1 ONLY. A visual inspection will be performed to ensure the scope of work items as described in FIM-8 in Section 4 of this IGA report were completed. No further annual M&V will be performed.

Pre-FIM Measurements

1. Window area

Post-FIM Measurements

1. Visual inspection of windows to ensure proper installation of film

Stipulated Parameters

Stipulated parameters were based on current equipment nameplates, drawings, and engineering estimates as defined in the table that follows for each building.

New Courthouse Window Replacement	
Window Area	8,466 ft^2
% Solar Heat Rejection	56%
Cooling Equipment Efficiency	1.2 kW/ton
Solar Radiation Data Location, NREL	Syracuse, NY
Existing Window U Value	0.64 Btu/hr-ft^2-°F
Window U Value Including Film	0.33 Btu/hr-ft^2-°F

Savings Calculation Method

Energy savings are calculated with a spreadsheet analysis. Cooling savings are associated with a reduction in solar heat gain and heating savings result due to a decrease in the U value of the window. The spreadsheet mode is presented in Appendix B.

FIM-9: Replace Transformers

SmartWatt will replace 7 transformers with premium efficiency units at the County Office Building and the Veterans Building.

M&V Option

Option A was selected to provide a cost effective means to evaluate savings.

Overview of M&V Activities

M&V for this FIM will be performed in Year 1 ONLY. A factory test will be utilized to determine the losses at the loads measured during the on-site test.

Pre-FIM Measurements

1. Transformer size
2. Transformer input power
3. Transformer losses

Post-FIM Measurements

1. Transformer input power (factory test at same input power as the Pre-FIM measurement)
2. Transformer output power
3. Transformer losses

Stipulated Parameters

A representative sample of transformers were metered and their baseline loads and losses measured.

Savings Calculation Method

Energy savings are calculated based on a decrease in transformer losses. Based on the results of the metering sample the expected efficiencies were determined. The losses of the custom-built transformers will be tested at the manufacturer at the same input load as measured on-site.

$$Annual\ kWh\ Savings = Measured\ Baseline\ Losses - Measured\ Post\ Installation\ Losses$$

$$Annual\ \$\ Savings\ =\ Annual\ kWh\ Savings\ \times \frac{\$}{kWh} Rate$$

5.5 Risk, Responsibility, and Performance

Performance Period Responsibilities

This section details the responsibilities of Madison County and SmartWatt in connection with the management and administration of the measurement and verification plan.

1. Madison will provide a representative at the Facility to provide energy usage information and energy-using equipment information, as requested by SmartWatt. This information will include, but not be limited to:
    a. Copies of all utility and fuel bills for the Facilities; for the two years prior to the M&V Services Commencement Date and ongoing throughout the Term;
    b. Access to trended data reports from the Energy Management Systems (Metasys), with permission granted to SmartWatt to download any and all information from these systems and to store such information for the Term;
    c. Permission to install, at SmartWatt's expense, add-on devices to any and all utility and energy use meters, to enable SmartWatt to directly observe Facility utility usage, with permission granted to SmartWatt to download any and all information from these systems and to store such information for the Term;
    d. Permission to obtain and utilize any and all energy usage information from any and all utilities or energy suppliers providing service to the Facilities, with permission granted to SmartWatt to download any and all information from these systems and to store such information for the Term.
    e. Copies of any and all energy-using equipment repair orders or invoices for repairs or maintenance work not subject to the direct control of SmartWatt.

Equipment Service and Modification

The County shall not move, remove, modify, alter, or change the Equipment or any part thereof ("Alterations") in any way without the prior written approval of SmartWatt, except in the event of a *bona fide* emergency where it is not reasonably possible to notify SmartWatt before carrying out Alterations. In the event of such an emergency, the County shall take reasonable steps to protect the Equipment from damage or injury, shall follow any instructions for emergency action provided in advance by SmartWatt, and shall notify SmartWatt within three (3) business days of such emergency. Any telephonic notice of such emergency shall be followed within one (1) business day by written notice to SmartWatt from the County. The County agrees to maintain the Facilities in good repair and to protect and preserve all portions thereof that may in any way affect the operation or maintenance of the Equipment.

In the event that any actions of the County, including but not limited to the carrying out of Alterations, affect the performance of the Equipment, the Guaranteed Energy Savings shall be adjusted to reflect the impact of such actions. If the County unreasonably delays in notifying SmartWatt of changes resulting from an emergency and/or County does not receive written approval to carry out Alterations, all Guaranteed Energy Savings obligations of SmartWatt shall automatically cease and be of no further force or effect.

At all times during the Term, SmartWatt shall have the right, subject to County's prior written approval to change the Equipment or any related energy automation management systems, revise any procedures for the operation thereof, and/or implement other energy saving actions in the Facilities, provided that: (I) such modifications are necessary, in SmartWatt's reasonable judgment, to enable SmartWatt to achieve the Guaranteed Energy Savings at the Facilities, and (ii) any cost incurred relative to such modifications, additions or replacement of the Equipment, or operational changes or new procedures shall be the responsibility of SmartWatt. All such modifications, additions or replacements of the Equipment or revisions to operating or other procedures shall be described in a supplemental schedule to be provided to the County.

Operations & Maintenance, Training, and Warranties

It is the County's responsibility to operate the installed equipment according to manufacturer specifications and according to the training provided either through in-house staff or existing O&M contracts at the buildings. SmartWatt will provide training on each major piece of installed equipment, O&M manuals, as-builts where applicable and maintenance tasking sheets in order to assist with the proper maintenance of the equipment. During the guarantee period, SmartWatt will be responsible for Measurement and Verification of the energy savings resulting from the performance of the equipment installed. Issues with the way the equipment is being operated and/or maintained will be communicated to the County so that the situation can be remedied.

Training for the facility staff and maintenance personnel on the new equipment and procedures is a key component in ensuring the energy savings are maintained throughout the life of the contract term. SmartWatt has a strong, vested interest in providing highly effective training. Training will be provided

by SmartWatt personnel, as well as manufacturer's representatives. SmartWatt will coordinate with the County to determine the appropriate County staff to be included in each training session for each FIM. Training will be conducted as soon as practical after each FIM is completed.

SmartWatt warrants that all materials and equipment furnished under the Construction and Installation Phase of this Agreement will be new unless otherwise specified, of good quality, in conformance with the Scope of Work and all documents associated therewith, and free from defective workmanship and materials. Warranties with respect to the Work, or applicable portion of the Work, as the case may be, shall commence on the date of Substantial Completion thereof (as hereinafter defined). SmartWatt agrees to correct all Work that is defective in workmanship or materials within a period of one (1) year from the date of Substantial Completion. SmartWatt shall collect, deliver, and, to the extent permissible, assign all manufacturers' warranties and Equipment manuals to the County. There are no warranties that extend beyond the description on the face of any such warranty.

6.0 Summary

6.1 Financial Summary

The cash flow presented below demonstrates that an energy savings project can be accomplished through a self-funding program requiring no capital investment. Our analysis demonstrates that Madison County can complete improvements valued at $2,740,518. In addition, the use of available utility incentives will reduce the upfront costs by $172,777. Table 29 provides an overview of the cash flow assumptions. Table 30 provides the project cash flow including a cumulative cash flow of about **$97,145** at the end of the financing term of 17 years and **$653,707** after 20 years.

Table 29 - Cash Flow Summary

Project Total Investment	$2,740,518
Utility Incentive	$172,777
Net Project Investment	$2,567,740
Year 1 Electric Savings	$83,965
Year 1 Natural Gas Savings	$17,358
Year 1 Lighting Material Replacement Savings	$12,325
Year 1 Equipment Repair & Replacements Savings	$91,955
Interest Rate	3.085%
Term	17 years

Table 30 - Project Cash Flow

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Electric Savings	$ -	$ 83,965	$ 86,635	$ 89,390	$ 92,232	$ 95,165	$ 98,192	$ 101,314	$ 104,536	$ 107,860	$ 111,290
Natural Gas Savings		$ 17,358	$ 18,128	$ 18,933	$ 19,774	$ 20,652	$ 21,569	$ 22,527	$ 23,527	$ 24,571	$ 25,662
Propane Gas Savings	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Water Savings	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Utility Savings	$ -	$ 101,323	$ 104,763	$ 108,323	$ 112,006	$ 115,817	$ 119,761	$ 123,841	$ 128,063	$ 132,432	$ 136,953
Lighting Replacement Savings	$ -	$ 12,325	$ 12,695	$ 13,075	$ 13,468	$ 13,872	$ 14,288	$ 14,716	$ 15,158	$ 15,613	$ 16,081
Equipment Repair & Replacment Savings		$ 91,955	$ 115,314	$ 139,873	$ 160,181	$ 91,790	$ 99,999	$ 37,707	$ 38,666	$ 39,625	$ 40,583
Total Project savings	**$ -**	**$ 205,603**	**$ 232,772**	**$ 261,271**	**$ 285,655**	**$ 221,479**	**$ 234,047**	**$ 176,264**	**$ 181,887**	**$ 187,669**	**$ 193,617**
Outstanding Balance	$ 2,567,740	$ 2,567,740	$ 2,447,679	$ 2,292,677	$ 2,104,462	$ 1,886,125	$ 1,725,301	$ 1,547,022	$ 1,421,102	$ 1,285,753	$ 1,140,528
Principal Payment	$ -	$ 120,061	$ 155,002	$ 188,215	$ 218,336	$ 160,824	$ 178,279	$ 125,920	$ 135,349	$ 145,225	$ 155,570
Interest Payment		$ 79,215	$ 75,511	$ 70,729	$ 64,923	$ 58,187	$ 53,226	$ 47,726	$ 43,841	$ 39,665	$ 35,185
Measurement and Verification		$ 6,326	$ 2,258	$ 2,326	$ 2,395	$ 2,467	$ 2,541	$ 2,617	$ 2,696	$ 2,777	$ 2,860
Service Contract		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Project Payments	**$ -**	**$ 205,602**	**$ 232,771**	**$ 261,270**	**$ 285,654**	**$ 221,478**	**$ 234,046**	**$ 176,263**	**$ 181,886**	**$ 187,668**	**$ 193,616**
Net annual benefits from Total Project	$ -	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1
Cummulative Payment for Project		$ 205,602	$ 438,372	$ 699,643	$ 985,297	$ 1,206,775	$ 1,440,821	$ 1,617,084	$ 1,798,970	$ 1,986,638	$ 2,180,254
Cummulative Project Savings	$ -	**$ 205,603**	**$ 438,374**	**$ 699,646**	**$ 985,301**	**$ 1,206,780**	**$ 1,440,827**	**$ 1,617,091**	**$ 1,798,978**	**$ 1,986,647**	**$ 2,180,264**
Cumulative Cash Flow	**$ -**	**$ 1**	**$ 2**	**$ 3**	**$ 4**	**$ 5**	**$ 6**	**$ 7**	**$ 8**	**$ 9**	**$ 10**

	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Total
Total Utility Savings	$ 141,631	$ 146,473	$ 151,483	$ 156,669	$ 162,035	$ 167,590	$ 173,339	$ 179,289	$ 185,448	$ 191,824	$ 2,839,062
Total Maintenance Savings	$ 16,563	$ 17,060	$ 17,572	$ 18,099	$ 18,642	$ 19,202	$ 19,778	$ -	$ -	$ -	$ 1,123,899
Total Project savings	**$ 158,194**	**$ 163,533**	**$ 169,055**	**$ 174,768**	**$ 180,678**	**$ 186,791**	**$ 193,117**	**$ 179,289**	**$ 185,448**	**$ 191,824**	**$ 3,962,961**
Outstanding Balance	$ 984,958	$ 860,096	$ 726,133	$ 582,605	$ 429,030	$ 264,905	$ 89,702	$ -	$ -	$ -	
Principal Payment	$ 124,862	$ 133,964	$ 143,528	$ 153,574	$ 164,125	$ 175,203	$ 89,702	$ -	$ -	$ -	$ 2,567,740
Interest Payment	$ 30,386	$ 26,534	$ 22,401	$ 17,973	$ 13,236	$ 8,172	$ 2,767	$ -	$ -	$ -	$ 689,677
Measurement and Verification	$ 2,946	$ 3,034	$ 3,125	$ 3,219	$ 3,316	$ 3,415	$ 3,518	$ -	$ -	$ -	$ 51,837
Service Contract	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Project Payments	**$ 158,193**	**$ 163,532**	**$ 169,054**	**$ 174,767**	**$ 180,677**	**$ 186,790**	**$ 95,987**	**$ -**	**$ -**	**$ -**	**$ 3,309,254**
Net annual benefits from Total Project	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 97,129	$ 179,289	$ 185,448	$ 191,824	$ 653,707
Cummulative Payment for Project	$ 2,338,447	$ 2,501,979	$ 2,671,033	$ 2,845,800	$ 3,026,477	$ 3,213,267	$ 3,309,254	$ 3,309,254	$ 3,309,254	$ 3,309,254	
Cummulative Project Savings	$ 2,338,458	$ 2,501,991	$ 2,671,046	$ 2,845,814	$ 3,026,492	$ 3,213,283	$ 3,406,400	$ 3,585,689	$ 3,771,138	$ 3,962,961	
Cumulative Cash Flow	**$ 11**	**$ 12**	**$ 13**	**$ 14**	**$ 15**	**$ 16**	**$ 97,145**	**$ 276,435**	**$ 461,883**	**$ 653,707**	

6.2 Project Management and Schedule

SmartWatt, along with several other ESCOs, has been pre-selected by National Grid to perform work under its UESC program based on qualifications. Following completion of the IGA, it is anticipated that the County will, under agreement with National Grid, opt to move forward to implementation. SmartWatt will then be contracted to implement the project including design and construction.

Geoff Frey, Senior Project Manager, at SmartWatt will have the overall responsibility for managing and executing the construction phase of this project. The table below lists the major milestones for this project. Additional detail is provided in the attached Work Breakdown Schedule. The dates below are approximates. A detailed WBS will be provided as part of the Project Management Plan presented during the construction phase.

Table 31 Major Milestone Summary Table

Milestone	Date
Contract Award	2/26/16
Kickoff Meeting	3/17/16
Lighting Upgrades - Complete	6/1/16
Replace Water Source Heat Pumps - Complete	8/1/16
Building Envelope Improvements - Complete	6/1/16
Energy Management System Upgrades - Complete	8/1/16
ECM Motor Upgrades - Complete	6/1/16
Replace Boilers - Complete	9/1/16
Replace Domestic Hot Water Heaters - Complete	9/1/16
Install Window Tinting - Complete	7/1/16
Replace Transformers - Complete	10/1/16
Project Closeout	10/17/16

Appendix A – Baseline Utility Data

Baseline Year (2014) Usage Summary by Building

Facility	Electric Usage (kWh/yr)	Natural Gas Usage (therm/yr)	Water Usage (CCF/yr)
COB / Courthouse / Public Health	1,531,617	48,628	1,526
Jail	851,400	32,525	3,200
DSS	732,000	5,828	538
VETS	270,880	11,080	337
Maintenance Garage	12,194	2,399	33
Highway Garage - Wampsville	171,619	26,573	
Total	**3,569,710**	**127,033**	**5,634**

Baseline Year (2014) Monthly Usage Summary by Building

COB / Courthouse / Public Health

Electric

Month	kWh
Jan	112,637
Feb	108,107
Mar	106,843
Apr	117,580
May	137,043
Jun	136,414
Jul	164,981
Aug	135,921
Sep	147,839
Oct	128,144
Nov	109,466
Dec	126,642
Total	**1,531,617**

Natural Gas

Month	Therms
Jan	9,314
Feb	7,984
Mar	7,350
Apr	4,086
May	2,181
Jun	674
Jul	387
Aug	518
Sep	1,395
Oct	1,876
Nov	5,501
Dec	7,362
Total	**48,628**

Water/Sewer

Month	CCF
Apr	206
Jul	523
Oct	597
Jan	200
Total	**1,526**

Veterans Building

Electric

Month	kWh
Jan	27,680
Feb	26,240
Mar	25,440
Apr	20,640
May	20,960
Jun	19,520
Jul	25,920
Aug	19,680
Sep	20,160
Oct	18,240
Nov	20,640
Dec	25,760
Total	**270,880**

Natural Gas

Month	Therms
Jan	2,072
Feb	1,900
Mar	1,971
Apr	954
May	450
Jun	116
Jul	53
Aug	60
Sep	208
Oct	368
Nov	1,134
Dec	1,794
Total	**11,080**

Water/Sewer

Month	CCF
Apr	73
Jul	98
Oct	105
Jan	61
Total	**337**

Facilities Maintenance Garage

Electric

Month	kWh
Jan	1,103
Feb	1,098
Mar	1,051
Apr	917
May	1,028
Jun	968
Jul	1,394
Aug	926
Sep	966
Oct	756
Nov	911
Dec	1,076
Total	**12,194**

Natural Gas

Month	Therms
Jan	549
Feb	536
Mar	482
Apr	226
May	47
Jun	-
Jul	-
Aug	-
Sep	-
Oct	22
Nov	173
Dec	364
Total	**2,399**

Water/Sewer

Month	CCF
Apr	8
Jul	9
Oct	9
Jan	7
Total	**33**

DSS Building

Electric

Month	kWh
Jan	74,400
Feb	69,300
Mar	65,700
Apr	51,600
May	56,400
Jun	50,700
Jul	67,800
Aug	53,400
Sep	56,700
Oct	53,400
Nov	62,100
Dec	70,500
Total	**732,000**

Natural Gas

Month	Therms
Jan	1,489
Feb	1,150
Mar	1,063
Apr	396
May	137
Jun	18
Jul	9
Aug	22
Sep	34
Oct	93
Nov	468
Dec	949
Total	**5,828**

Water/Sewer

Month	CCF
Apr	98
Jul	157
Oct	191
Jan	92
Total	**538**

Jail/PSB

Electric

Month	kWh
Jan	81,900
Feb	73,500
Mar	72,000
Apr	59,700
May	67,200
Jun	66,900
Jul	93,000
Aug	70,800
Sep	70,800
Oct	60,600
Nov	64,200
Dec	70,800
Total	**851,400**

Natural Gas

Month	Therms
Jan	5,340
Feb	4,959
Mar	4,698
Apr	2,681
May	1,726
Jun	1,186
Jul	1,186
Aug	990
Sep	1,206
Oct	1,387
Nov	2,742
Dec	4,424
Total	**32,525**

Water/Sewer

Month	CCF
Apr	800
Jul	1,000
Oct	600
Jan	800
Total	**3,200**

Highway Department (Wampsville)

Electric

Month	kWh
Jan	25,247
Feb	24,598
Mar	22,372
Apr	16,021
May	11,997
Jun	10,159
Jul	8,867
Aug	8,185
Sep	8,764
Oct	8,185
Nov	9,762
Dec	17,462
Total	**171,619**

Natural Gas

Month	Therms
Jan	6,402
Feb	5,869
Mar	5,683
Apr	1,906
May	585
Jun	52
Jul	46
Aug	44
Sep	118
Oct	292
Nov	1,856
Dec	3,720
Total	**26,573**

Appendix B – FIM Calculations

Table of Contents

FIM #: 2
Title Replace Water Source Heat Pumps
Project: Madison County
Site: DSS, Jail, Veterans Building

Description Replace WSHPs not replaced in the last three years with high efficiency Carrier units.

DSS Savings Summary		
60,776	Electric Savings	kWh/yr
$ 5,470	Electric $ Savings	$/yr
198	Heating Savings	Therms/yr
$ 170	Heating Savings	$/yr
$ 5,640	Total Energy Savings	$/yr

Jail Savings Summary		
113,673	Electric Savings	kWh/yr
$ 10,117	Electric $ Savings	$/yr
1,036	Heating Savings	Therms/yr
$ 811	Heating Savings	$/yr
$ 10,928	Total Energy Savings	$/yr

Veterans		
30,102	Electric Savings	kWh/yr
$ 2,890	Electric $ Savings	$/yr
684	Heating Savings	Therms/yr
$ 559	Heating Savings	$/yr
$ 3,449	Total Energy Savings	$/yr

DSS Baseline Conditions		
Determined using Carrier HAP Building Simulation		
5,828	Total Natural Gas Usage	Therms/yr
5,129	HVAC NG Usage	Therms/yr
732,000	Total Electricity Usage	kWh/yr
198,424	HVAC Electric Usage	kWh/yr

Jail Baseline Conditions		
Determined using Carrier HAP Building Simulation		
32,525	Total Natural Gas Usage	Therms/yr
19,286	HVAC NG Usage	Therms/yr
851,400	Total Electricity Usage	kWh/yr
352,286	HVAC Electric Usage	kWh/yr

Veterans Baseline Conditions		
Determined using Carrier HAP Building Simulation		
11,080	Total Natural Gas Usage	Therms/yr
10,481	HVAC NG Usage	Therms/yr
270,880	Total Electricity Usage	kWh/yr
103,923	HVAC Electric Usage	kWh/yr

WSHP Replacement Savings Estimation

DSS Building

Model Parameters/Assumptions		
Cooling Utilization	39%	
Heating Utilization	9%	
Cooling Hours (OAT >50)	3,554	hours
Heating Hours (OAT <45)	4,036	hours
Adjusted Cooling Hours	1,391	hours
Adjusted Heating Hours	357	hours
Boiler Efficiency	92.0%	
Electricity usage Cost	0.090	/kWh
Electricity Demand cost		/kW
Gas Cost	$ 0.858	/therm

Electrical Cost Summary	Existing	Proposed	Saving
Electrical Consumption (kWh)	198,424	137,648	60,776
Electrical Consumption Cost ($)	17,858	12,388	$ 5,470
Electrical Demand (kW/yr)	807	572	235
Electrical Cooling Demand Cost ($)	0	0	0
Total Electrical Savings ($)		$5,470	

Natural Gas Cost Summary	Existing	Proposed	Saving
Gas Use (therms)	5,129	4,931	198
Gas Cost ($)	$ 4,401	$ 4,231	$ 170

Annual Cost Savings ($)	
Annual Cost Savings ($)	$ 5,640
Annual CO2 Savings (Metric Tons)	15

Existing Energy Use

Equipment Information						Cooling Performance					Heating Performance						
Unit Tag	Manufacturer	Model	Qty	Cooling Capacity	Heating Capacity	Total Cooling Capacity	EER	Power Usage	Peak Demand	Energy Usage	Total Heating Capacity	COP	Power Usage	Peak Demand	Energy Usage	Total Heating Output	*Natural Gas Usage
				(MBH)	(MBH)	(MBH)		(MBH)	(kW)	(kWh)	(MBH)		(MBH)	(kW)	(kWh)	(MBtu)	therms
1	McQuay	LHP010D	1	111.9	117.8	112	13.6	28.1	8.22	11,436	118	3.7	31.8	9.33	3,328	42,031	343
2	McQuay	LHP010D	1	112.9	118.4	113	13.6	28.3	8.30	11,544	118	3.8	31.1	9.13	3,257	42,241	344
A	McQuay	CCH007C	5	7.6	9.7	38	12.6	10.2	3.00	4,171	49	3.9	12.4	3.64	1,300	17,311	141
B	McQuay	CCH009C	2	9.4	11.9	19	12.7	5.1	1.48	2,060	24	4.0	5.9	1.74	621	8,473	69
E	McQuay	CCH019C	9	19.2	23.1	172	14.5	40.6	11.88	16,525	207	4.0	51.9	15.20	5,424	74,043	604
E	Bosch	LV018	2	21.4	22.7	43	17.0	8.6	2.52	3,500	45	4.8	9.5	2.77	989	16,204	132
F	McQuay	CCH024C	4	26.1	29.6	105	13.6	26.2	7.69	10,689	118	4.1	28.9	8.46	3,020	42,259	345
G	McQuay	CCH030C	7	31.5	38.9	221	13.5	55.7	16.33	22,715	272	4.0	68.1	19.95	7,119	97,189	792
G	Bosch	LV030	1	32.7	34.8	33	17.9	6.2	1.83	2,540	35	4.7	7.4	2.17	774	12,421	101
H	McQuay	CCH036C	10	37.9	42.1	379	13.7	94.3	27.82	38,410	421	4.1	102.6	30.06	10,728	150,120	1,224
I	McQuay	CCH042C	4	42.5	49.1	170	13.2	44.0	12.88	17,918	196	4.0	49.1	14.37	5,129	70,027	571
I	Bosch	CCH042C	2	44.4	48.7	89	16.8	18.0	5.28	7,349	97	4.8	20.3	5.95	2,122	34,764	283
K	McQuay	WMHC018C	2	18.9	21.1	38	18.9	6.8	2.00	2,781	42	4.6	9.2	2.70	965	15,090	123
K	McQuay	WMH019C	1	17.1	19.6	17	17.1	3.4	1.00	1,390	20	3.3	5.9	1.74	620	6,985	57
		Total	51			1,547		375.6	110.04	153,027	1,763		434	127.19	45,397.47	629,157.33	5,129

Proposed Energy Use

Equipment Information						Cooling Performance						Heating Performance						
Unit Tag	Manufacturer	Model	Qty	Cooling Capacity	Heating Capacity	Total Cooling Capacity	EER	Cooling Load Factor Adjustment	Power Usage	Peak Demand	Energy Usage	Total Heating Capacity	COP	Heating Load Factor Adjustment	Power Usage	Peak Demand	Energy Usage	Total Heating Output	*Natural Gas Usage
				(MBH)	(MBH)	(MBH)			(MBH)	(kW)	(kWh)	(MBH)			(MBH)	(kW)	(kWh)	(MBtu)	therms
1	Carrier	50VQP120	1	131.8	158.2	132	18.5	0.85	20.6	6.05	8,407	158	4.7	0.74	25.1	7.34	2,620	42,031	343
2	Carrier	50VQP120	1	131.8	158.2	132	18.5	0.86	20.8	6.10	8,487	158	4.7	0.75	25.2	7.38	2,633	42,241	344
A	Carrier	50PSH007	5	7.4	8.6	37	16.8	1.00	7.5	2.20	3,062	43	5.0	1.00	8.6	2.52	899	15,347	125
B	Carrier	50PSH007	2	7.4	8.6	15	16.8	1.00	3.0	0.88	1,225	17	5.0	1.00	3.4	1.01	360	6,139	50
E	Carrier	50PSH019	10	20.5	22.4	205	20.9	0.93	31.3	9.16	12,739	224	5.2	1.00	43.1	12.62	4,505	79,950	652
E	Bosch	LV018	1	21.4	22.7	21	17.0	1.00	4.3	1.26	1,750	23	4.8	1.00	4.7	1.39	495	8,102	66
F	Carrier	50PSH024	4	27.5	31.4	110	22.3	0.95	16.0	4.69	6,519	126	5.4	0.94	21.9	6.42	2,293	42,259	345
G	Carrier	50PSH030	7	30.4	33.8	213	20.7	1.00	35.1	10.28	14,292	237	5.7	1.00	41.5	12.16	4,341	84,447	688
G	Bosch	LV030	1	32.7	34.8	33	17.9	1.00	6.2	1.83	2,540	35	4.7	1.00	7.4	2.17	774	12,421	101
H	Carrier	50PSH036	10	37.8	46.4	378	20.1	1.00	64.2	18.80	26,145	464	5.8	0.91	72.5	21.25	7,584	150,120	1,224
I	Carrier	50PSH042	5	44.8	47.8	224	23.8	0.95	30.5	8.93	12,422	239	6.0	1.00	39.8	11.67	4,166	85,303	695
I	Bosch	CCH042C	1	44.4	48.7	44	16.8	1.00	9.0	2.64	3,674	49	4.8	1.00	10.1	2.97	1,061	17,382	142
K	McQuay	WMHC018C	2	18.9	21.1	38	18.9	1.00	6.8	2.00	2,781	42	4.6	1.00	9.2	2.70	965	15,090	123
K	Carrier	50PEC09	1	10.2	11.3	10	20.5	1.00	1.7	0.50	692	11	5.4	1.00	2.1	0.61	219	4,033	33
		Total	51			1,592			257.0	75.31	104,733	1,826			315	92	32,914	604,865	4,931

* Assumes that 75% of the heat produced comes from the boilers, 25% comes from the heat generated by the heat pump (compressors, motors, friction, etc…)

Jail

Model Parameters/Assumptions		
Cooling Utilization	50%	
Heating Utilization	40%	
Cooling Hours (OAT >50)	3,554	hours
Heating Hours (OAT <45)	4,036	hours
Adjusted Cooling Hours	1,765	hours
Adjusted Heating Hours	1,629	hours
Boiler Efficiency	94.0%	
Electricity usage Cost	0.089	/kWh
Electricity Demand cost		/kW
Gas Cost	$ 0.783	/therm

Electrical Cost Summary	Existing	Proposed	Saving
Electrical Consumption (kWh)	352,286	238,613	113,673
Electrical Consumption Cost ($)	31,353	21,237	$ 10,117
Electrical Demand (kW/yr)	705	481	224
Electrical Cooling Demand Cost ($)	0	0	0
Total Electrical Savings ($)		$10,117	

Natural Gas Cost Summary	Existing	Proposed	Saving
Gas Use (therms)	19,286	18,250	1,036
Gas Cost ($)	$ 15,101	$ 14,290	$ 811
100%	% of HVAC NG Usage		

Annual Cost Savings ($)	
Annual Cost Savings ($)	$ 10,928
Annual CO2 Savings (Metric Tons)	29

Existing Energy Use

Equipment Information						Cooling Performance					Heating Performance						
Unit Tag	Manufacturer	Model	Qty	Cooling Capacity	Heating Capacity	Total Cooling Capacity	EER	Power Usage	Peak Demand	Energy Usage	Total Heating Capacity	COP	Power Usage	Peak Demand	Energy Usage	Total Heating Output	*Natural Gas Usage
				(MBH)	(MBH)	(MBH)		(MBH)	(kW)	(kWh)	(MBH)		(MBH)	(kW)	(kWh)	(MBtu)	therms
A	McQuay	CCH023	3	26.1	31.6	78	13.6	19.7	5.76	10,172	95	4.1	23.1	6.77	11,038	154,459	1,232
B	McQuay	CCH019	1	19.2	23.2	19	14.5	4.5	1.32	2,330	23	4.0	5.8	1.70	2,769	37,800	302
B	McQuay	CCV023	3	26.1	31.6	78	13.6	19.7	5.76	10,172	95	4.1	23.1	6.77	11,038	154,459	1,232
C	McQuay	CCV026	1	26.1	31.6	26	13.6	6.6	1.92	3,391	32	4.1	7.7	2.26	3,679	51,486	411
D	McQuay	CCH030C	2	31.5	38.9	63	13.5	15.9	4.67	8,235	78	4.0	19.5	5.70	9,285	126,761	1,011
E	McQuay	CCV030C	8	31.5	38.9	252	13.5	63.7	18.67	32,939	311	4.0	77.8	22.80	37,140	507,042	4,046
E	McQuay	CCV030C	1	31.5	38.9	32	13.5	8.0	2.33	4,116	39	4.0	9.7	2.85	4,643	63,380	506
F	McQuay	CCH042C	1	42.5	49.1	43	13.2	11.0	3.22	5,684	49	4.0	12.3	3.59	5,854	79,918	638
G	McQuay	CCV042C	3	42.5	49.1	128	13.2	33.0	9.66	17,051	147	4.0	36.8	10.78	17,562	239,753	1,913
G	McQuay	CCV042C	1	42.5	49.1	43	13.2	11.0	3.22	5,684	49	4.0	12.3	3.59	5,854	79,918	638
H	McQuay	CCH050C	1	50.0	65.0	50	13.2	12.9	3.79	6,682	65	4.0	16.3	4.76	7,757	105,905	845
I	McQuay	FCV009	1	9.5	10.9	10	10.9	3.0	0.87	1,537	11	4.0	2.7	0.80	1,301	17,760	142
J	McQuay	CCH019C	2	19.2	23.2	38	11.1	11.8	3.45	6,087	46	4.1	11.3	3.32	5,403	75,600	603
J	McQuay	CCH019C	1	19.2	23.2	19	14.5	4.5	1.32	2,330	23	4.0	5.8	1.70	2,769	37,800	302
K	McQuay	CCH007	4	7.6	9.1	30	12.6	8.2	2.40	4,234	36	3.9	9.3	2.73	4,456	59,307	473
K	McQuay	CCH007	1	7.6	9.1	8	12.6	2.0	0.60	1,058	9	3.9	2.3	0.68	1,114	14,827	118
L	McQuay	FCV060	5	65.1	75.0	326	10.6	104.8	30.70	54,169	375	4.0	93.8	27.47	44,755	610,992	4,875
		Total	39			1,242		340.2	99.67	175,870	1,484		370	108.28	176,416	2,417,166.78	19,286

Proposed Energy Use

Equipment Information						Cooling Performance						Heating Performance						
Unit Tag	Manufacturer	Model	Qty	Cooling Capacity	Heating Capacity	Total Cooling Capacity	EER	Cooling Load Factor Adjustment	Power Usage	Peak Demand	Energy Usage	Total Heating Capacity	COP	Heating Load Factor Adjustment	Power Usage	Peak Demand	Energy Usage	Total Heating Output	*Natural Gas Usage
				(MBH)	(MBH)	(MBH)			(MBH)	(kW)	(kWh)	(MBH)			(MBH)	(kW)	(kWh)	(MBtu)	therms
A	Carrier	50PSH030	3	30.4	33.8	91	21.3	0.86	12.6	3.68	6,495	101	5.6	0.93	16.9	4.96	8,081	154,459	1,232
B	McQuay	CCH019	1	19.2	23.2	19	14.5	1.00	4.5	1.32	2,330	23	4.0	1.00	5.8	1.70	2,769	37,800	302
B	Carrier	50PSV030	3	30.4	33.8	91	21.3	0.86	12.6	3.68	6,495	101	5.6	0.93	16.9	4.96	8,081	154,459	1,232
C	McQuay	CCV026	1	26.1	31.6	26	13.6	1.00	6.6	1.92	3,391	32	4.1	1.00	7.7	2.26	3,679	51,486	411
D	Carrier	50PSH036	2	46.4	37.8	93	20.1	0.68	10.7	3.13	5,531	76	5.8	1.00	13.0	3.82	6,222	123,176	983
E	Carrier	50PSV036	8	46.4	37.8	371	20.1	0.68	42.8	12.54	22,123	302	5.8	1.00	52.1	15.28	24,890	492,704	3,931
E	McQuay	CCV030C	1	31.5	38.9	32	13.5	1.00	8.0	2.33	4,116	39	4.0	1.00	9.7	2.85	4,643	63,380	506
F	Carrier	50PSH042	1	44.8	47.8	45	23.8	0.95	6.1	1.79	3,152	48	6.0	1.00	8.0	2.33	3,803	77,881	621
G	Carrier	50PSV042	3	44.8	47.8	134	23.8	0.95	18.3	5.36	9,457	143	6.0	1.00	23.9	7.00	11,409	233,643	1,864
G	McQuay	CCV042C	1	42.5	49.1	43	13.2	1.00	11.0	3.22	5,684	49	4.0	1.00	12.3	3.59	5,854	79,918	638
H	Carrier	50PSH048	1	51.4	57.9	51	22.0	0.97	7.8	2.27	4,009	58	5.7	1.00	10.2	2.98	4,849	94,337	753
I	Carrier	50PSV012	1	12.7	15.7	13	17.1	0.75	1.9	0.56	980	16	4.5	0.69	2.4	0.71	1,151	17,760	142
J	Carrier	50PSH019	2	20.5	22.4	41	20.9	0.93	6.3	1.83	3,233	45	5.2	1.00	8.6	2.52	4,113	72,993	582
J	McQuay	CCH019C	1	19.2	23.2	19	14.5	1.00	4.5	1.32	2,330	23	4.0	1.00	5.8	1.70	2,769	37,800	302
K	Carrier	50PSH012	4	12.7	15.7	51	17.1	0.60	6.0	1.77	3,120	63	4.5	0.58	8.1	2.36	3,844	59,307	473
K	McQuay	CCH007	1	7.6	9.1	8	12.6	1.00	2.0	0.60	1,058	9	3.9	1.00	2.3	0.68	1,114	14,827	118
L	Carrier	50PSV060	5	79.2	64.0	396	19.1	0.82	58.1	17.04	30,063	320	5.5	1.00	58.2	17.05	27,775	521,380	4,160
		Total	39			1,524			219.7	64.36	113,565	1,448			262	77	125,048	2,287,311	18,250

* Assumes that 75% of the heat produced comes from the boilers, 25% comes from the heat generated by the heat pump (compressors, motors, friction, etc…)

Veterans

Model Parameters/Assumptions		
Cooling Utilization	5%	
Heating Utilization	38%	
Cooling Hours (OAT >50)	3,554	hours
Heating Hours (OAT <45)	4,036	hours
Adjusted Cooling Hours	184	hours
Adjusted Heating Hours	1,548	hours
Boiler Efficiency	92.0%	
Electricity usage Cost	0.096	/kWh
Electricity Demand cost		/kW
Gas Cost	$ 0.817	/therm

Electrical Cost Summary	Existing	Proposed	Saving
Electrical Consumption (kWh)	103,923	73,821	30,102
Electrical Consumption Cost ($)	9,977	7,087	$ 2,890
Electrical Demand (kW/yr)	394	267	127
Electrical Cooling Demand Cost ($)	0	0	0
Total Electrical Savings ($)		$2,890	

Natural Gas Cost Summary	Existing	Proposed	Saving
Gas Use (therms)	10,481	9,797	684
Gas Cost ($)	$ 8,563	$ 8,004	$ 559

Annual Cost Savings ($)	
Annual Cost Savings ($)	$ 3,449
Annual CO2 Savings (Metric Tons)	8

Existing Energy Use

Equipment Information						Cooling Performance					Heating Performance						
Unit Tag	Manufacturer	Model	Qty	Cooling Capacity	Heating Capacity	Total Cooling Capacity	EER	Power Usage	Peak Demand	Energy Usage	Total Heating Capacity	COP	Power Usage	Peak Demand	Energy Usage	Total Heating Output	*Natural Gas Usage
				(MBH)	(MBH)	(MBH)		(MBH)	(kW)	(kWh)	(MBH)		(MBH)	(kW)	(kWh)	(MBtu)	therms
1	Command Aire	SWPH 190EA	3	18.5	24.5	56	11.0	17.2	5.04	928	74	4.0	18.4	5.38	8,334	113,769	927
2	Command Aire	SWPH 260EA	2	24.0	32.0	48	11.0	14.9	4.36	803	64	4.1	15.6	4.57	7,079	99,064	808
2	McQuay	CCH024A	3	26.1	29.6	78	13.6	19.7	5.76	1,061	89	4.1	21.7	6.35	9,823	137,452	1,121
2	McQuay	CCV026	1	26.1	29.6	26	13.6	6.6	1.92	354	30	4.1	7.2	2.12	3,274	45,817	374
3	Command Aire	SWPH 280EA	4	30.0	40.0	120	11.0	37.2	10.91	2,007	160	4.0	40.0	11.72	18,141	247,661	2,019
3	McQuay	CCH030A	2	31.5	38.9	63	13.5	15.9	4.67	859	78	4.0	19.5	5.70	8,821	120,425	982
3	McQuay	CCH030A	1	31.5	38.9	32	13.5	8.0	2.33	429	39	4.0	9.7	2.85	4,411	60,213	491
4	Command Aire	SWPH 350EA	4	36.0	48.0	144	11.0	44.7	13.09	2,408	192	4.0	48.0	14.06	21,769	297,193	2,423
5	Command Aire	SWPH 410EA	2	42.0	53.0	84	11.0	26.1	7.63	1,405	106	4.0	26.5	7.76	12,018	164,075	1,338
		Total	22			651		190.2	55.72	10,253	831		207	60.52	93,670	1,285,669	10,481

Proposed Energy Use

Equipment Information						Cooling Performance						Heating Performance						
Unit Tag	Manufacturer	Model	Qty	Cooling Capacity	Heating Capacity	Total Cooling Capacity	EER	Cooling Load Factor Adjustment	Power Usage	Peak Demand	Energy Usage	Total Heating Capacity	COP	Heating Load Factor Adjustment	Power Usage	Peak Demand	Energy Usage	Total Heating Output	*Natural Gas Usage
				(MBH)	(MBH)	(MBH)			(MBH)	(kW)	(kWh)	(MBH)			(MBH)	(kW)	(kWh)	(MBtu)	therms
1	Carrier	50PSH019	3	20.5	22.4	62	20.9	0.90	9.1	2.65	489	67	5.2	1.00	12.9	3.79	5,861	104,018	848
2	Carrier	50PSH024	2	27.5	31.4	55	22.3	0.87	7.3	2.15	396	63	5.4	1.00	11.6	3.41	5,274	97,207	792
2	McQuay	CCH024A	3	26.1	29.6	78	13.6	1.00	19.7	5.76	1,061	89	4.1	1.00	21.7	6.35	9,823	137,452	1,121
2	Carrier	50PSH024	1	27.5	31.4	28	22.3	0.95	4.0	1.17	216	31	5.3	0.94	5.6	1.64	2,533	45,817	374
3	Carrier	50PSH030	4	30.4	33.8	122	20.7	0.99	19.8	5.80	1,066	135	5.7	1.00	23.7	6.95	10,757	209,273	1,706
3	McQuay	CCH030A	2	31.5	38.9	63	13.5	1.00	15.9	4.67	859	78	4.0	1.00	19.5	5.70	8,821	120,425	982
3	Carrier	50PSH030	1	30.4	33.8	30	20.7	1.00	5.0	1.47	270	34	5.7	1.00	5.9	1.74	2,689	52,318	427
4	Carrier	50PSH036	4	37.8	46.4	151	20.1	0.95	24.4	7.16	1,318	186	5.8	1.00	32.0	9.38	14,513	287,287	2,342
5	Carrier	50PSH042	2	44.8	47.8	90	23.8	0.94	12.0	3.53	649	96	6.0	1.00	15.9	4.67	7,226	147,977	1,206
		Total	22			678			117.3	34.36	6,323	778			149	44	67,497	1,201,774	9,797

* Assumes that 75% of the heat produced comes from the boilers, 25% comes from the heat generated by the heat pump (compressors, motors, friction, etc...)

FIM #: 3
Title Building Envelope Upgrades
Project: Madison County
Site:

Description Seal cracks and gaps in the building envelope to reduce infiltration.

Given:

Building	Heating Unit Cost ($/therm)	Heating Fuel	Electric Cost ($/kWh)
County Office Building	$ 0.75	Natural Gas	$ 0.090
Veterans Building	$ 0.82	Natural Gas	$ 0.096
DSS	$ 0.86	Natural Gas	$ 0.090
Public Health	$ 0.75	Natural Gas	$ 0.090
Jail	$ 0.78	Natural Gas	$ 0.089
Hwy Department (Wampsville)	$ 0.81	Natural Gas	$ 0.116

ENERGY CONVERSIONS & CONSTANTS

1 therm = 100,000 Btu

Fuel		Units
Natural Gas	1	therm/ccf
Oil	1.38	therm/gallon
Propane	0.91	therm/gallon
Other	*>> must be pre-converted into therms*	
Electric	0.03412	therm/kWh

Assumptions:

Building	% Infiltration / Exfiltration	Local Shielding Class	Number of Stories	Average Wind Speed (mph)	Heating Efficiency	Cooling Efficiency (kW/ton)
County Office Building	50%	3	2	7.9	92%	1.2
Veterans Building	50%	3	2	7.9	92%	1.2
DSS	50%	3	2	7.9	92%	1.2
Public Health	50%	3	2	7.9	92%	1.2
Jail	50%	3	1	7.9	92%	1.2
Hwy Department (Wampsville)	50%	3	1	7.9	80%	1.2

Building	Occupied Space Heating Setpoint	Unnoccupied Space Heating Setpoint	Average OA Temp During Heating Season Occupied Hours	Average OA Temp During Heating Season Unoccupied Hours	Heating Season Occupied Hours	Heating Season Unoccupied Hours
County Office Building	70	65	36.1	37.4	1516	4460
Veterans Building	70	65	36.1	37.4	1516	4460
DSS	70	65	36.1	37.4	1516	4460
Public Health	70	65	36.1	37.4	1516	4460
Jail	70	72	36.1	37.4	5976	0
Hwy Department (Wampsville)	70	65	36.1	37.4	1516	4460

Building	Occupied Space Cooling Setpoint	Unnoccupied Space Cooling Setpoint	Cooling System Supply Air Enthalpy (Btu/lbm)	Average OA Temp During Cooling Season Occupied Hours	Average Outside Air Enthalpy During Occupied Hours (Btu/lbm)	Average OA Temp During Cooling Season Unoccupied Hours	Average Outside Air Enthalpy During Unoccupied Hours (Btu/lbm)	Cooling Season Occupied Hours	Cooling Season Unoccupied Hours
County Office Building	74	80	24	77	31.5	76	32	551	466
Veterans Building	74	80	24	77	31.5	76	32	551	466
DSS	74	80	24	77	31.5	76	32	551	466
Public Health	74	80	24	77	31.5	76	32	551	466
Jail	74	80	24	77	31.5	76	32	1017	0
Hwy Department (Wampsville)	0	0	24	77	31.5	76	32	0	0

Crack Estimate Summary:

Building	Existing Crack Area Sq.Ft
County Office Building	7.4
Veterans Building	3.5
DSS	13.3
Public Health	4.4
Jail	12.8
Hwy Department (Wampsville)	10.2
Total	51.7

County Office Building

Work to be completed	No. of Units	Average Perimeter (ft)	Total Perimeter (ft)	Crackage (in)	Conversion to feet		Product	
Single door weather-stripping	5	20	100	1/16	1/12	=	0.52	
Double door weather-stripping	2	20	40	1/8	1/12	=	0.42	
Roof top ventilator sealing	3	6.7	20.0	1/6	1/12	=	0.28	*assume roof fans open during occupied hours
Window caulking	1	595	595	1/8	1/12	=	6.20	
						Total =	7.41	ft^2

Veterans Building

Work to be completed	No. of Units	Average Perimeter (ft)	Total Perimeter (ft)	Crackage (in)	Conversion to feet		Product	
Single door weather-stripping	4	20	80	1/16	1/12	=	0.42	
Double door weather-stripping	1	40	40	1/8	1/12	=	0.42	
Roof top ventilator sealing	8	4	32	1/6	1/12	=	0.44	*assume roof fans open during occupied hours
Soffit joint sealing	1	87	87	3/16	1/12	=	1.36	
Roof/wall joint sealing	1	173	173	1/16	1/12	=	0.90	
						Total =	3.54	ft^2

DSS

Work to be completed	No. of Units	Average Perimeter (ft)	Total Perimeter (ft)	Crackage (in)	Conversion to feet		Product	
Single door weather-stripping	3	20	60	1/32	1/12	=	0.16	
Double door weather-stripping	2	20	40	1/16	1/12	=	0.21	
Roof top ventilator sealing	2	4	8	1/6	1/12	=	0.11	*assume roof fans open during occupied hours
Roof/wall joint sealing	1	614	614	1/4	1/12	=	12.79	
						Total =	13.27	ft^2

Public Health

Work to be completed	No. of Units	Average Perimeter (ft)	Total Perimeter (ft)	Crackage (in)	Conversion to feet		Product	
Single door weather-stripping	4	20	80	1/16	1/12	=	0.42	
Roof top ventilator sealing	4	9	36	1/6	1/12	=	0.50	*assume roof fans open during occupied hours
Exterior caulking	1	14	14	1/8	1/12	=	0.15	
Stud Wall Sheathing	1	650	650	1/16	1/12	=	3.39	
						Total =	4.45	ft^2

Jail

Work to be completed	No. of Units	Average Perimeter (ft)	Total Perimeter (ft)	Crackage (in)	Conversion to feet		Product	
Single door weather-stripping	12	20	240	1/16	1/12	=	1.25	Note: 2 interior doors are not included in savings calculations
Double door weather-stripping	1	40	40	1/16	1/12	=	0.21	
Exterior closet door weather-stripp	4	16	64	1/16	1/12	=	0.33	
Garage door weather-stripping	8	41	328	1/8	1/12	=	3.42	
Roof top ventilator sealing	6	5.33	31.98	1/6	1/12	=	0.44	*assume roof fans open during occupied hours
Roof/wall joint sealing	1	345	345	1/4	1/12	=	7.19	
						Total =	12.84	ft^2

Hwy Department (Wampsville) **Garage**

Work to be completed	No. of Units	Average Perimeter (ft)	Total Perimeter (ft)	Crackage (in)	Conversion to feet		Product
Single door weather-stripping	7	20	140	1/16	1/12	=	0.73
Garage door weather-stripping	7	64	448	1/4	1/12	=	9.33
						Total =	10.06 ft^2

Hwy Department (Wampsville) **Office Bldg**

Work to be completed	No. of Units	Average Perimeter (ft)	Total Perimeter (ft)	Crackage (in)	Conversion to feet		Product
Single door weather-stripping	1	20	20	1/16	1/12	=	0.10
						Total =	0.10 ft^2

Calculation:

Leakage Rate (CFM) = Crack Area (ft^2) x 144 ($in^2/ft^{2)}$ x Infiltration to Exfiltration Ratio x SQRT ((Stack Coefficient x ABS(Temperature Setpoint - Outside Air Temperature)) + (Wind Coefficient x Avg Wind Velocity^2))
Heating Energy Savings (therms) = 1.08 x Leakage Rate x (Heating Setpoint - Outside Air Temperature) x Hours per Year / (100,000 Btu/therm) / Heating System Efficiency
Cooling Energy Savings (kWh) = 4.5 x Leakage Rate x (Outside Air Enthalpy - Cooling Air Enthalpy) x Hours per Year x Cooling Efficiency (kW/ton) / (12,000 Btu/ton)

Building	Stack Coefficient A	Wind Coefficient B	Occupied Heating Savings (Therms)	Unoccupied Heating Savings (Therms)	Occupied Cooling Savings (kWh)	Unoccupied Cooling Savings (kWh)	Total Heating Savings (therms)	Total Cooling Savings (kWh)	Annual Cost Savings (Heating)	Annual Cost Savings (Cooling)	Total Annual Cost Savings
County Office Building	0.0299	0.0086	400	898	784	715	1,298	1,499	$ 975	$ 135	$ 1,110
Veterans Building	0.0299	0.0086	191	429	374	341	620	715	$ 506	$ 69	$ 575
DSS	0.0299	0.0086	716	1,607	1,404	1,279	2,323	2,683	$ 1,993	$ 241	$ 2,235
Public Health	0.0299	0.0086	240	539	471	429	779	899	$ 585	$ 81	$ 666
Jail	0.015	0.0065	2,098	-	2,126	-	2,098	2,126	$ 1,643	$ 189	$ 1,832
Hwy Department (Wampsville)	0.015	0.0065	485	1,098	-	-	1,583	-	$ 1,282	$ -	$ 1,282
						Totals	**8,701**	**7,923**	**$ 6,985**	**$ 715**	**$ 7,700**

STACK COEFFICIENT	
# of Stories	Coeff A
1	0.015
2	0.0299
3	0.0449
4	0.062833333
5	0.078583333
6	0.094333333
7	0.110083333
8	0.125833333
9	0.141583333
10	0.157333333

	WIND COEFFICIENT				
	Shielding Class				
# of Stories	1	2	3	4	5
1	0.0119	0.0092	0.0065	0.0039	0.0012
2	0.0157	0.0121	0.0086	0.0051	0.0016
3	0.0184	0.0143	0.0101	0.006	0.0018
4	0.021833333	0.016966667	0.012	0.0071	0.002133333
5	0.025083333	0.019516667	0.0138	0.00815	0.002433333
6	0.028333333	0.022066667	0.0156	0.0092	0.002733333
7	0.031583333	0.024616667	0.0174	0.01025	0.003033333
8	0.034833333	0.027166667	0.0192	0.0113	0.003333333
9	0.038083333	0.029716667	0.021	0.01235	0.003633333
10	0.041333333	0.032266667	0.0228	0.0134	0.003933333

LOCAL SHIELDING CLASSES	
CLASS	DESCRIPTION
1	No obstructions or local shielding
2	Light Local shielding; few obstructions, few trees, or small shed
3	Moderate local shielding, some obstructions within two house heights, thick hedge, solid fence, or one neighboring house
4	Heavy shielding; obstuctions around most of perimeter, buildings or trees within 30 ft in most directions; typical suburban shielding.
5	Very heavy shielding; large obstructins surrounding perimeter within tow house heights; typical downtown shielding

FIM #: 3
Title Insulation
Project: Madison County
Site: Public Health Bldg

Heating System Efficiency:	92%
Fuel Cost ($/therm)	$0.751
Fuel Cost ($/MMBtu):	$7.51
Building Section:	Wall Area
Surface Area (ft^2):	650
Existing U-Value (U_i):	0.2
Proposed U-Value (U_o):	0.05

R-Value	5
R-Value	20

Existing Occupied Conductive Loss

Existing U-Value (U_i)	Surface Area (ft^2)	Indoor Temperature (˚F)	Outdoor Temperature (˚F)	Heating Degree Days (HDD)	Percent Occupied (%/week)	Fuel Cost ($/MMBtu)	Heating System Efficiency (%)	Thermal Loss Direction (%)	Heat Loss ($)
0.200	650	70	36.1	6785	30%	$7.51	92%	75%	$54.44

Proposed Occupied Conductive Loss

Existing U-Value (U_i)	Surface Area (ft^2)	Indoor Temperature (˚F)	Outdoor Temperature (˚F)	Heating Degree Days (HDD)	Percent Occupied (%/week)	Fuel Cost ($/MMBtu)	Heating System Efficiency (%)	Thermal Loss Direction (%)	Heat Loss ($)
0.050	650	70	36.1	6785	30%	$7.51	92%	75%	$13.61

Occupied Conductive Loss Savings

Existing Heat Loss ($/yr)	Proposed Heat Loss ($/yr)	Occupied Heat Savings ($/yr)
$54.44	$13.61	$40.83

Existing Unoccupied Conductive Loss

Existing U-Value (U_i)	Surface Area (ft^2)	Indoor Temperature (˚F)	Outdoor Temperature (˚F)	Heating Degree Days (HDD)	Percent Unoccupied (%/week)	Fuel Cost ($/MMBtu)	Heating System Efficiency (%)	Thermal Loss Direction (%)	Heat Loss ($/yr)
0.200	650	65	37.4	6785	70%	$7.51	92%	75%	$104.55

Proposed Unoccupied Conductive Loss

Existing U-Value (U_i)	Surface Area (ft^2)	Indoor Temperature (˚F)	Outdoor Temperature (˚F)	Heating Degree Days (HDD)	Percent Unoccupied (%/week)	Fuel Cost ($/MMBtu)	Heating System Efficiency (%)	Thermal Loss Direction (%)	Heat Loss ($/yr)
0.050	650	65	37.4	6785	70%	$7.51	92%	75%	$26.14

Unoccupied Conductive Loss Savings

Existing Heat Loss ($/yr)	Proposed Heat Loss ($/yr)	Unoccupied Heat Savings ($/yr)
$104.55	$26.14	$78.41

Total Savings (MMBtu/yr)	Total Savings ($/yr)
15.88	$119.25

FIM #: 4
Title Provide for Optimal Start During Heating Season
Project: Madison County
Site: County Office Bldg, Courthouse, DSS, Public Health, Veterans Building

Description Provide for optimal start/stop controls for the above buildings. Occupied and unoccupied schedules will be changed to reflect Outside Air Temperature.

County Office Building Savings Summary		
230	Heating Savings	Therms/yr
$ 173	Heating Savings	$/yr
4,895	Fan Savings	kWh/yr
$ 441	Fan Savings	$/yr

Public Health Savings Summary		
130	Heating Savings	Therms/yr
$ 98	Heating Savings	$/yr
1,895	Fan Savings	kWh/yr
$ 171	Fan Savings	$/yr

Veterans Building Savings Summary		
257	Heating Savings	Therms/yr
$ 210	Heating Savings	$/yr
-	Fan Savings	kWh/yr
$ -	Fan Savings	$/yr

Courthouse Savings Summary		
188	Heating Savings	Therms/yr
$ 141	Heating Savings	$/yr
2,100	Fan Savings	kWh/yr
$ 189	Fan Savings	$/yr

DSS Building Savings Summary		
544	Heating Savings	Therms/yr
$ 467	Heating Savings	$/yr
-	Fan Savings	kWh/yr
$ -	Fan Savings	$/yr

Total Savings Summary		
1,349	Heating Savings	Therms/yr
$1,088	Heating Savings	$/yr
8,890	Fan Savings	kWh/yr
$800	Fan Savings	$/yr

County Office Building Savings Estimate

Building Operating Schedule (M-F):	Open	8:00 AM	Close	5:00 PM
Building Total CFM:	32,000			
OA % Minimum Occupied	12%			
Occupied Temperature Setpoint	70			
Heating System Efficiency	92%			
Fan Power (HP)	37.5			
Fan Load Factor	90%			
Fan Motor Efficiency	90%			

Heating Season					Current Schedule				Warmup Reduction			Savings	
Month	Working Days per Month	Average Outside Air Temperature During Warmup (F)	HDD	% of max. HDD	Start	Stop	Hrs/Day	Current Building Warmup Time (hours)	Required Building Warmup Time (hours)	Warmup Time Reduction per Day (hours)	Warmup Time Reduction per Month (hours)	Heating Savings (therm)	Fan Power Savings (kWh)
October	23	46.3	460	36%	5:30 AM	5:00 PM	11.50	2.50	0.89	1.61	37.06	40	1037
November	22	37.5	478	37%	5:30 AM	5:00 PM	11.50	2.50	0.92	1.58	34.68	52	970
December	20	20.2	1,108	86%	5:30 AM	5:00 PM	11.50	2.50	2.14	0.36	7.19	16	201
January	21	22.9	1,294	100%	5:30 AM	5:00 PM	11.50	2.50	**2.50**	0.00	0.00	0	0
February	20	24.5	1,131	87%	5:30 AM	5:00 PM	11.50	2.50	2.19	0.31	6.30	13	176
March	22	24.4	959	74%	5:30 AM	5:00 PM	11.50	2.50	1.85	0.65	14.24	30	398
April	21	35.9	572	44%	5:30 AM	5:00 PM	11.50	2.50	1.11	1.39	29.29	46	819
May	23	54.9	254	20%	5:30 AM	5:00 PM	11.50	2.50	0.49	2.01	46.21	32	1293
											Totals	230	4,895

Veterans Building Savings Estimate

Building Operating Schedule (M-F):	Open	8:00 AM	Close	5:00 PM
Building Total CFM:	21,900			
OA % Minimum Occupied	20%			
Occupied Temperature Setpoint	70			
Heating System Efficiency	92%			

Fan Power (HP)	0.0
Fan Load Factor	90%
Fan Motor Efficiency	95%

Heating Season					Current Schedule				Warmup Reduction			Savings	
Month	Working Days per Month	Average Outside Air Temperature During Warmup (F)	HDD	% of max. HDD	Start	Stop	Hrs/Day	Current Building Warmup Time (hours)	Required Building Warmup Time (hours)	Warmup Time Reduction per Day (hours)	Warmup Time Reduction per Month (hours)	Heating Savings (therm)	Fan Power Savings (kWh)
October	23	46.3	460	36%	5:30 AM	5:00 PM	11.50	2.50	0.89	1.61	37.06	45	0
November	22	37.5	478	37%	5:30 AM	5:00 PM	11.50	2.50	0.92	1.58	34.68	58	0
December	20	20.2	1,108	86%	5:30 AM	5:00 PM	11.50	2.50	2.14	0.36	7.19	18	0
January	21	22.9	1,294	100%	5:30 AM	5:00 PM	11.50	2.50	**2.50**	0.00	0.00	0	0
February	20	24.5	1,131	87%	5:30 AM	5:00 PM	11.50	2.50	2.19	0.31	6.30	15	0
March	22	24.4	959	74%	5:30 AM	5:00 PM	11.50	2.50	1.85	0.65	14.24	33	0
April	21	35.9	572	44%	5:30 AM	5:00 PM	11.50	2.50	1.11	1.39	29.29	51	0
May	23	54.9	254	20%	5:30 AM	5:00 PM	11.50	2.50	0.49	2.01	46.21	36	0
											Totals	257	0

DSS Savings Estimate

Building Operating Schedule (M-F):	Open	**8:00 AM**	Close	**5:00 PM**
Building Total CFM:	46,412			
OA % Minimum Occupied	20%			
Occupied Temperature Setpoint	70			
Heating System Efficiency	92%			
Fan Power (HP)	0.0			
Fan Load Factor	90%			
Fan Motor Efficiency	85%			

Heating Season					Current Schedule				Warmup Reduction			Savings	
Month	Working Days per Month	Average Outside Air Temperature During Warmup (F)	HDD	% of max. HDD	Start	Stop	Hrs/Day	Current Building Warmup Time (hours)	Required Building Warmup Time (hours)	Warmup Time Reduction per Day (hours)	Warmup Time Reduction per Month (hours)	Heating Savings (therm)	Fan Power Savings (kWh)
October	23	46.3	460	36%	5:30 AM	5:00 PM	11.50	2.50	0.89	1.61	37.06	96	0
November	22	37.5	478	37%	5:30 AM	5:00 PM	11.50	2.50	0.92	1.58	34.68	123	0
December	20	20.2	1,108	86%	5:30 AM	5:00 PM	11.50	2.50	2.14	0.36	7.19	39	0
January	21	22.9	1,294	100%	5:30 AM	5:00 PM	11.50	2.50	**2.50**	0.00	0.00	0	0
February	20	24.5	1,131	87%	5:30 AM	5:00 PM	11.50	2.50	2.19	0.31	6.30	31	0
March	22	24.4	959	74%	5:30 AM	5:00 PM	11.50	2.50	1.85	0.65	14.24	71	0
April	21	35.9	572	44%	5:30 AM	5:00 PM	11.50	2.50	1.11	1.39	29.29	109	0
May	23	54.9	254	20%	5:30 AM	5:00 PM	11.50	2.50	0.49	2.01	46.21	76	0
											Totals	544	0

Public Health Savings Estimate

Building Operating Schedule (M-F):	Open	**8:00 AM**	Close	**5:00 PM**
Building Total CFM:	11,075			
OA % Minimum Occupied	20%			
Occupied Temperature Setpoint	70			
Heating System Efficiency	92%			
Fan Power (HP)	15.0			
Fan Load Factor	90%			
Fan Motor Efficiency	93%			

Heating Season	Current Schedule	Warmup Reduction	Savings

Month	Working Days per Month	Average Outside Air Temperature During Warmup (F)	HDD	% of max. HDD	Start	Stop	Hrs/Day	Current Building Warmup Time (hours)	Required Building Warmup Time (hours)	Warmup Time Reduction per Day (hours)	Warmup Time Reduction per Month (hours)	Heating Savings (therm)	Fan Power Savings (kWh)
October	23	46.3	460	36%	5:30 AM	5:00 PM	11.50	2.50	0.89	1.61	37.06	23	401
November	22	37.5	478	37%	5:30 AM	5:00 PM	11.50	2.50	0.92	1.58	34.68	29	376
December	20	20.2	1,108	86%	5:30 AM	5:00 PM	11.50	2.50	2.14	0.36	7.19	9	78
January	21	22.9	1,294	100%	5:30 AM	5:00 PM	11.50	2.50	**2.50**	0.00	0.00	0	0
February	20	24.5	1,131	87%	5:30 AM	5:00 PM	11.50	2.50	2.19	0.31	6.30	7	68
March	22	24.4	959	74%	5:30 AM	5:00 PM	11.50	2.50	1.85	0.65	14.24	17	154
April	21	35.9	572	44%	5:30 AM	5:00 PM	11.50	2.50	1.11	1.39	29.29	26	317
May	23	54.9	254	20%	5:30 AM	5:00 PM	11.50	2.50	0.49	2.01	46.21	18	500
											Totals	**130**	**1,895**

Courthouse Savings Estimate

Building Operating Schedule (M-F):	Open	**8:00 AM**	Close	**5:00 PM**
Building Total CFM:	16,000			
OA % Minimum Occupied	20%			
Occupied Temperature Setpoint	70			
Heating System Efficiency	92%			
Fan Power (HP)	16.0			
Fan Load Factor	90%			
Fan Motor Efficiency	90%			

Heating Season					Current Schedule				Warmup Reduction			Savings	
Month	Working Days per Month	Average Outside Air Temperature During Warmup (F)	HDD	% of max. HDD	Start	Stop	Hrs/Day	Current Building Warmup Time (hours)	Required Building Warmup Time (hours)	Warmup Time Reduction per Day (hours)	Warmup Time Reduction per Month (hours)	Heating Savings (therm)	Fan Power Savings (kWh)
October	23	46.3	460	36%	5:30 AM	5:00 PM	11.50	2.50	0.89	1.61	37.06	33	445
November	22	37.5	478	37%	5:30 AM	5:00 PM	11.50	2.50	0.92	1.58	34.68	42	416
December	20	20.2	1,108	86%	5:30 AM	5:00 PM	11.50	2.50	2.14	0.36	7.19	13	86
January	21	22.9	1,294	100%	5:30 AM	5:00 PM	11.50	2.50	**2.50**	0.00	0.00	0	0
February	20	24.5	1,131	87%	5:30 AM	5:00 PM	11.50	2.50	2.19	0.31	6.30	11	76
March	22	24.4	959	74%	5:30 AM	5:00 PM	11.50	2.50	1.85	0.65	14.24	24	171
April	21	35.9	572	44%	5:30 AM	5:00 PM	11.50	2.50	1.11	1.39	29.29	38	352
May	23	54.9	254	20%	5:30 AM	5:00 PM	11.50	2.50	0.49	2.01	46.21	26	555
											Totals	**188**	**2,100**

FIM #: 4
Title: Turn off fans during unoccupied hours
Project: Madison County
Site: County Office Building (FCU 1 and FCU 4)

Electric Energy Rate	0.090	$/kWh
Total Fan Size	15	HP
Existing Operating Hours per Week	168	hours/week
Occupied Operating Hours per Week	60	hours/week
Operating Weeks per Year	50	weeks/year
Cycling Factor for off hours runtime	10%	
Proposed Operating Hours	70.8	
Fan System Load Factor	75%	
Fan System Motor Efficiency	91%	

Formula

Baseline Motor Energy Use = (HorsePower x Load Factor x 0.746 x operating hours x operating weeks) / Motor Efficiency
Proposed Motor Energy Use = (HorsePower x Load Factor x 0.746 x proposed hours x operating weeks) / Motor Efficiency

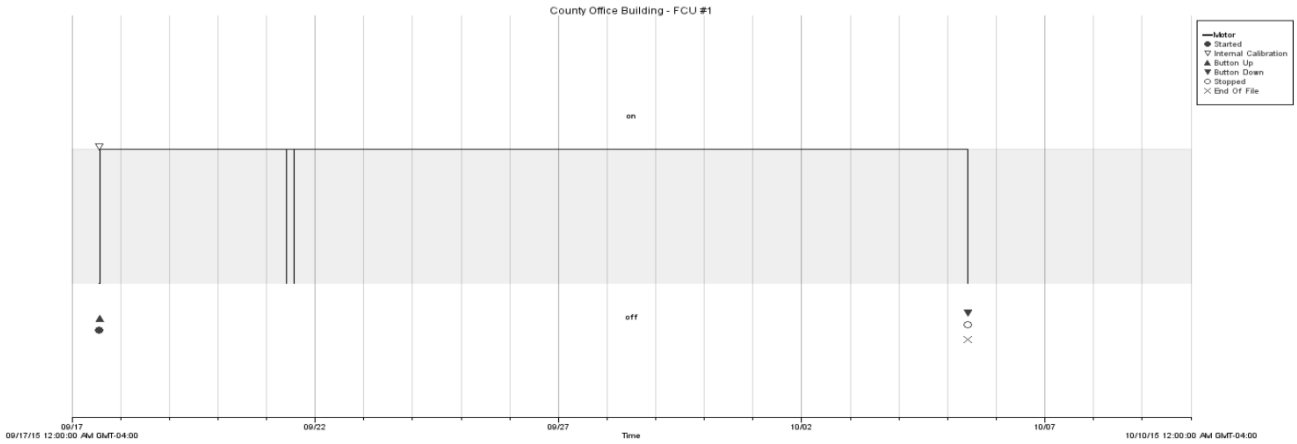
Calculation

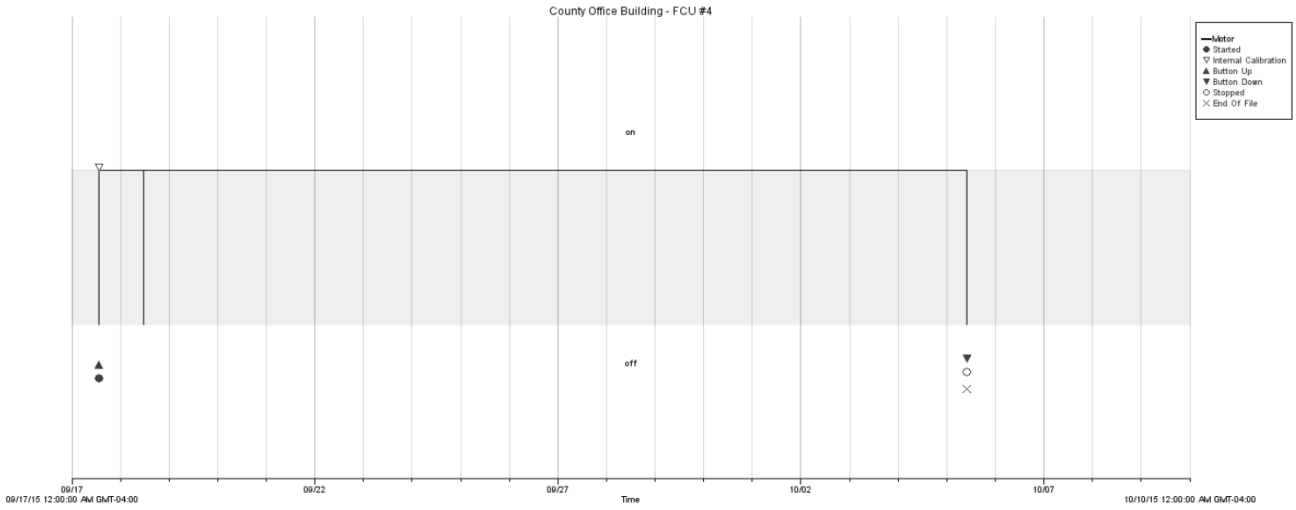
		HP		Load Factor		Conversion		Existing Hrs		Operating Weeks		Motor Efficency		
Baseline Motor Energy Use	=(	15	x	75%	x	0.746	x	168	x	50	) /	91%	**77,469**	**kWh**

		HP		Load Factor		Conversion		Proposed Hrs		Operating Weeks		Motor Efficiency		
Proposed Motor Energy Use	=(	15	x	75%	x	0.746	x	70.8	x	50	) /	91%	**32,648**	**kWh**

Existing Annual Motor Use =		**77,469**	**kWh/yr**
Existing Annual Motor Electric Cost =	**$**	**6,972**	

Annual Motor Savings =		**44821**	**kWh/yr**
Annual Cost Savings =	**$**	**4,034**	





FIM #: 5
Title: Install ECM Motors on Coolers/Freezers
Project: Madison County
Site: Jail

Savings Summary		
6,850	Electric Savings	kWh/yr
$610	Electric $ Savings	$/yr

ECM Refrigeration Energy Calculations

Action #	Location	Motor Code	Total # of Motors	Baseline Watts per Motor	Total Motor Baseline KW	Total Motor Baseline kWh	Proposed EC Motor	Proposed Watts per Motor	Total Proposed Motor kW	Total Proposed Motor kWh	Total Motor kW Savings	Total Motor kWh Savings	Total Compressor Coincidence kWh Savings
1	Jail Cooler 1	1/15HP SP	1	136	0.136	1,191	Arktic 59 1/15th HP ECM 115/120V	46	0.046	402.96	0.09	788	353
2	Jail Cooler 2	1/15HP SP	1	136	0.136	1,191	Arktic 59 1/15th HP ECM 115/120V	46	0.046	402.96	0.09	788	353
3	Jail Freezer 1	1/15HP SP	2	136	0.272	2,383	Arktic 59 1/15th HP ECM 115/120V	46	0.092	805.92	0.18	1,577	706
4	Jail Freezer 2	1/15HP SP	2	136	0.272	2,383	Arktic 59 1/15th HP ECM 115/120V	46	0.092	805.92	0.18	1,577	706
		Total	6	544	0.816	7,148		184	0.276	2418	0.54	4,730	2,119
											Total kWh Savings		6,850

FIM #: 6
Title: Boiler Replacement
Project: Madison County
Site: PSB/Jail

Description: Install two new condensing hot water boilers.

TITLE:
PROJECT: Madison County
SITE: Jail

DESCRIPTION:

Units Chart			
$/MCF (Nat'l Gas)	1	1,030,000	btu/MCF
$/CCF (Nat'l Gas)	2	103,000	btu/CCF
$/CF (Nat'l Gas)	3	1,030	btu/CF
$/Therm (Nat'l Gas	4	100,000	btu/Therm
$/gal (LP Gas)	5	91,500	btu/gallon
$/gal (Fuel Oil #2)	6	139,000	btu/gallon
$/lb Steam	7	975	btu/lb Steam
$/1000 lbs Steam	8	975,000	btu/1000 lbs Steam

GIVEN:

Fuel Energy Cost	=	$0.78 4	Units from Chart
Boiler Plant Capacity	=	750	Mbh
Operation (Hours/Year)	=	5976	Hours/Year
Annual Heating Plant Energy Cost	=	$25,481	

ASSUMPTION:

Existing Efficiency (Combustion)	=	82.5%	
Existing Efficiency (Dist./Losses)	=	85%	
New Efficiency (Combustion)	=	94%	
New Efficiency (Dist./Losses)	=	90%	5% improvement associated with decreased cycling losses
Part Load Factor	=	30%	

FORMULA:
Energy Usage = (Capacity(Mbh)) x (Hours of Operation/Year) x (Part Load Factor) / (Combustion Efficiency x Distribution Efficiency)
Fuel Use (Unit) = (Usage (Mbh)) / (Heating Value of Fuel)
Fuel Energy Cost ($) = ((Fuel Use(Unit) x Fuel Cost($/Unit))

CALCULATION:

	Capacity	Hours/Year	Part Load Factor	Efficiency (Comb.)	Efficiency (Dist.)	
Existing Energy Usage = (	750)x(	5976)x(	30%)((	83%)x(	85%)) =	**1,928,600 Mbh**
New Energy Usage = (	750)x(	5976)x(	30%)((	94%)x(	90%)) =	**1,598,618 Mbh**

	Usage (Mbh)	Conversion(	Mbh/Therm)	
Existing Fuel Usage = (	1,928,600)/(	100) =		**19,286 Therm**
New Fuel Usage = (	1,598,618)/(	100) =		**15,986 Therm**

	Therm		$/fuel unit		
Existing Fuel Cost = (	**19,286**)*(	$0.783) =			**$ 15,101**
Existing Fuel Cost = (	**15,986**)*(	$0.783) =			**$ 12,517**

Result

Existing Annual Use =	**19,286 Therm**	**$**	**15,101**
Proposed Annual Use =	**15,986 Therm**	**$**	**12,517**
Annual Savings =	**3,300 Therm**	**$**	**2,584**
Savings as Percent of Existing	**=**		**17%**

FIM #: 7
Title: Domestic Hot Water Upgrades
Project: Madison County
Site: PSB/Jail

Description: Install two new condensing direct hot water heaters.

Natural Gas Cost	$0.783	$/therm

Water Survey Consumption Results		
Current Water Consumption	3,200	CCF/yr
Current Total Water Consumption	2,394	kGal/ yr
Toilets - PSB (non-inmate)	141	kGal/ yr
Toilets - Inmate Dorms	263	kGal/ yr
Toilets - Cells	572	kGal/ yr
Urinals - PSB (non-inmate)	48	kGal/ yr
Urinals - Inmate Dorms	117	kGal/ yr
Sinks - PSB	26	kGal/ yr
Sinks - Inmate Dorms	19	kGal/ yr
Sinks - Cells	17	kGal/ yr
Showers - PSB	12	kGal/ yr
Showers - Jail	413	kGal/ yr
Kitchen and Laundry	766	kGal/ yr
Sink Blended Warm Water as a % of Total Sink Use	95%	
Shower Blended Warm Water as a % of Total Shower Use	100%	
Kitchen and Laundry Warm Water Use as a % of Total Use	90%	
DHW Consumption of Heated Water	1,173	kGal/ yr
Baseline Domestic Hot Water Consumption and NG Usage		
Baseline DHW Consumption	1,173	kGal/ yr
Hot water temperature stored in tanks	140	F
Average cold water inlet temperature	47	F
Current HW heater efficiency	82%	
Current DHW Energy Input - NG	11,096	Therms / yr
Current DHW Annual Cost	8,688	$/yr
Proposed Domestic Hot Water Consumption and NG Usage		
Current DHW Consumption	1,173	kGal/ yr
Hot water temperature stored in tanks	140	F
Average cold water inlet temperature	47	F
Proposed domestic hot water efficiency	96%	
Proposed DHW Energy Input - NG	9,478	Therms / yr
Proposed DHW Annual Cost	7,421	$/yr
Annual Savings		
Annual NG Usage Reduction	1,618	Therms / yr
Annual NG Cost Savings	$ 1,267	$/yr

FIM #: 8
Title Window Tinting
Project: Madison County
Site: County Office Building

Description Window tinting all building windows.

Window film total solar heat rejected	56%	
Electric Consumption Cost	$ 0.09000	per kWh
Peak Electric Demand Cost	$ -	per kW
Electric Chiller Efficiency	1.20	kW/ton

Window Area

East Facing Area	2,238.0	SqFt	
South Facing Area	1,890.0	SqFt	Excluding Corridor
West Facing Area	2,570.0	SqFt	
North Facing Area	1,768.0	SqFt	
Total Area	8,466.0	SqFt	

Average Transmitted Solar Radiation, Syracuse, NY
Source: Solar Radiation Data Manual for Buildings, NREL

	Average Daily Transmitted Solar Radiation (Btu/sqft/day)			
Month	East	South	West	North
Jan	240	570	240	130
Feb	340	670	340	190
Mar	480	700	490	240
Apr	620	630	620	290
May	710	550	720	360
Jun	770	520	780	410
Jul	780	540	780	390
Aug	680	630	700	320
Sep	550	710	560	250
Oct	380	700	390	180
Nov	220	470	220	130
Dec	180	430	180	110

Calculation of Existing Cooling Load

		Average Cooling Load (Tons)					Total Cooling Load (Ton-hours)				
Month	# Cooling Days	East	South	West	North	Total	East	South	West	North	Total
Jan	0	-	-	-	-	-	-	-	-	-	-
Feb	0	-	-	-	-	-	-	-	-	-	-
Mar	0	-	-	-	-	-	-	-	-	-	-
Apr	0.0	-	-	-	-	-	-	-	-	-	-
May	31.0	6	4	6	2	18	4,105	2,685	4,780	1,644	13,215
Jun	30.0	6	3	7	3	19	4,308	2,457	5,012	1,812	13,589
Jul	31.0	6	4	7	2	19	4,510	2,637	5,179	1,781	14,106
Aug	31.0	5	4	6	2	18	3,931	3,076	4,647	1,462	13,116
Sep	30.0	4	5	5	2	15	3,077	3,355	3,598	1,105	11,135
Oct	15.0	3	5	3	1	12	1,063	1,654	1,253	398	4,367
Nov	0	-	-	-	-	-	-	-	-	-	-
Dec	0	-	-	-	-	-	-	-	-	-	-
Total	168					101					69,528

Calculation of Retrofit Load

	Average Cooling Load (Tons)	Total Cooling Load (Ton-hours)

Month	# Cooling Days	East	South	West	North	Total	East	South	West	North	Total
Jan	0	-	-	-	-	-	-	-	-	-	-
Feb	0	-	-	-	-	-	-	-	-	-	-
Mar	0	-	-	-	-	-	-	-	-	-	-
Apr	0.0	-	-	-	-	-	-	-	-	-	-
May	31.0	2	2	3	1	8	1,806	1,182	2,103	723	5,814
Jun	30.0	3	2	3	1	8	1,896	1,081	2,205	797	5,979
Jul	31.0	3	2	3	1	8	1,984	1,160	2,279	784	6,207
Aug	31.0	2	2	3	1	8	1,730	1,353	2,045	643	5,771
Sep	30.0	2	2	2	1	7	1,354	1,476	1,583	486	4,899
Oct	15.0	1	2	2	0	5	468	728	551	175	1,922
Nov	0	-	-	-	-	-	-	-	-	-	-
Dec	0	-	-	-	-	-	-	-	-	-	-
Total	168					44					30,592

Cooling Savings

Average Load	56	Tons
Total Load	38,936	Ton-hours
Electric Demand	68	kW
Electric Consumption	46,723	kWh
Dollar Savings	**$ 4,205**	

Heating Savings Calculation

Total Glass Area	8,466	sqft	Heating Efficiency	78.2%
Natural Gas Cost	$ 0.751	per Therm		

Existing Windows	
U Value	**0.64**

Windows with Tinting	
U Value	**0.33**

OAT	Hours	Inside Temp	Baseline Heat Loss (kBtu)	Retrofit Heat Loss (kBtu)	Savings (Therms)	Savings ($)
47.5	513	70	62,540	32,247	387.38	$ 290.92
42.5	553	70	82,398	42,486	510.38	$ 383.30
37.5	791	70	139,289	71,821	862.76	$ 647.93
32.5	821	70	166,814	86,014	1,033.25	$ 775.97
27.5	637	70	146,685	75,635	908.57	$ 682.33
22.5	572	70	147,214	75,907	911.85	$ 684.80
17.5	328	70	93,302	48,109	577.92	$ 434.01
12.5	169	70	52,652	27,149	326.13	$ 244.92
7.5	81	70	27,430	14,144	169.90	$ 127.59
2.5	38	70	13,898	7,166	86.09	$ 64.65
-2.5	29	70	11,392	5,874	70.56	$ 52.99
-7.5	17	70	7,139	3,681	44.22	$ 33.21
Total	**4,549**		**950,753**	**490,233**	**5,889**	**$ 4,423**

FIM #: 9
Title: Replace Transformers in the COB
Project: Madison County
Site: County Office Bldg

SMARTWATT Energy Inc.®

Adjustments / Efficiencies

Transformer Count	Tag Number	Building Name	Location ID or Room #	Transformer Designation	Existing kVA	Replacement kVA	Replace	% Load During Normal Operating Hours	% Load Outside Operating Hours	Equipment Operating hrs/day	Equipment Operating days/yr	Baseline Efficiency (Normal Operation)	Baseline Efficiency (Outside Op. hrs)	Powersmiths Efficiency (Normal Operation)	Powersmiths Efficiency (Outside Op. hrs)	A/C System Performance (kW/ton)
7	40003	COB	2Nd Fl Elec	LV5	30	30	1	24.8%	10.0%	16.0	255	93.8%	87.2%	98.2%	97.6%	0.75
8	40004	COB	B1 Mechanical Rm	TE1	30	30	1	24.8%	10.0%	16.0	255	93.8%	87.2%	98.2%	97.6%	0.75
9	40006	COB	B1 Mechanical Rm	HV1	45	45	1	10.9%	5.0%	16.0	255	90.6%	82.1%	97.9%	96.3%	0.75
10	40005	COB	B1 Mechanical Rm	T1	45	45	1	10.9%	5.0%	16.0	255	90.6%	82.1%	97.9%	96.3%	0.75
11	40007	COB	Womans Bathroom 1st Fl	T2	45	45	1	10.9%	5.0%	16.0	255	90.6%	82.1%	97.9%	96.3%	0.75
12	40008	COB	Treasurers Office 2nd Fl	T3	30	30	1	24.8%	10.0%	16.0	255	93.8%	87.2%	98.2%	97.6%	0.75
							6									

Baseline Transformer Losses

Baseline kW Losses (Normal Operation)	Baseline kW Losses (Outside Op. hrs)	Baseline Annual Additional kWh from Transformers	Total KW Loses	Baseline Annual Peak Demand KW Dollars	Baseline Annual Cost of Transformer Losses	Baseline Annual Additional kW from A/C (Peak)	Baseline Annual Additional kWh from A/C	Baseline Annual Cost of Associated A/C
0.49	0.44	4,083	0.94	$0.00	$ 367	0.11	870	$ 78
0.49	0.44	4,083	0.94	$0.00	$ 367	0.11	870	$ 78
0.51	0.49	4,361	1.00	$0.00	$ 392	0.11	929	$ 84
0.51	0.49	4,361	1.00	$0.00	$ 392	0.11	929	$ 84
0.51	0.49	4,361	1.00	$0.00	$ 392	0.11	929	$ 84
0.49	0.44	4,083	0.94	$0.00	$ 367	0.11	870	$ 78
3.00		25,329	5.80	$0	$2,280	0.64	5,397	$486

Powersmiths Transformer Losses

Powersmiths kW Losses (Normal Operation)	Powersmiths Transformer kW Losses (Outside Op. hrs)	Total KW Loses	Powersmiths Annual Peak Demand KW Dollars	Annual Cost of Powersmiths Transformer Losses	Powersmiths Annual Additional kW from A/C (Peak)	Powersmiths Annual Additional kWh from A/C	Powersmiths Annual Cost of Associated A/C
0.14	0.07	0.21	$0.00	$ 81	0.03	191	
0.14	0.07	0.21	$0.00	$ 81	0.03	191	
0.10	0.09	0.19	$0.00	$ 74	0.02	176	
0.10	0.09	0.19	$0.00	$ 74	0.02	176	
0.10	0.09	0.19	$0.00	$ 74	0.02	176	
0.14	0.07	0.21	$0.00	$ 81	0.03	191	
0.72		1.20	$0.00	$466	0.15	1,103	-

Annual Savings with Powersmiths

Baseline Total Annual Operating Cost	Powersmiths Total Annual Operating Cost	Peak kW Savings (Normal Op. Hrs.)	Peak Ton Cooling Savings	kW Dollar Savings	kWh Savings	kWh Dollar Savings (Includes Savings Associated with A/C)	Total Elec Dollar Savings
$ 446	$ 98	0.43	0.10	$0.00	3,863	$347.67	$347.67
$ 446	$ 98	0.43	0.10	$0.00	3,863	$347.67	$347.67
$ 476	$ 90	0.49	0.11	$0.00	4,286	$385.71	$385.71
$ 476	$ 90	0.49	0.11	$0.00	4,286	$385.71	$385.71
$ 476	$ 90	0.49	0.11	$0.00	4,286	$385.71	$385.71
$ 446	$ 98	0.43	0.10	$0.00	3,863	$347.67	$347.67
$2,765	$ 565	2.77	0.65	$0	24,446	$2,200	$2,200

FIM i 9
Title Provide for Optimal Start During Heating SeasoReplace Transformers in VETS
Proje Madison County
Site: Veterans Building

SMARTWATT Energy Inc.®

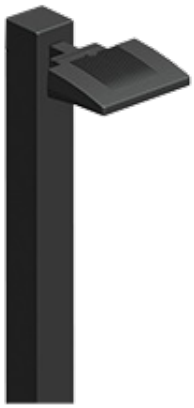
Transformer Count	Tag Number	Building Name	Location ID or Room #	Transformer Designation	Existing kVA	Replacement kVA	Replace	% Load During Normal Operating Hours	% Load Outside Operating Hours	Equipment Operating hrs/ day	Equipment Operating days/yr	Baseline Efficiency (Normal Operation)	Baseline Efficiency (Outside Op. hrs)	Powersmiths Efficiency (Normal Operation)	Powersmiths Efficiency (Outside Op. hrs)	A/C System Performance (kW/ton)
								Adjustments				Efficiencies				
1	40009	Veteran's Building	Main Electric Rm Basement	EMG	30	30	1	24.8%	10.0%	16.0	255	93.8%	87.2%	98.2%	97.6%	0
							1									

	Baseline kW Losses (Normal Operation)	Baseline kW Losses (Outside Op. hrs)	Baseline Annual Additional kWh from Transformers	Total kW Loses	Baseline Annual Peak Demand kW Dollars	Baseline Annual Cost of Transformer Losses	Baseline Annual Additional kW from A/C (Peak)	Baseline Annual Additional kWh from A/C	Baseline Annual Cost of Associated A/C	Powersmiths kW Losses (Normal Operation)	Powersmiths Transformer kW Losses (Outside Op. hrs)	Total kW Loses	Powersmiths Annual Peak Demand kW Dollars	Annual Cost of Powersmiths Transformer Losses	Powersmiths Annual Additional kW from A/C (Peak)	Powersmiths Annual Additional kWh from A/C	Powersmiths Annual Cost of Associated A/C	Baseline Total Annual Operating Cost	Powersmiths Total Annual Operating Cost	Peak kW Savings (Normal Op. Hrs.)	Peak Ton Cooling Savings	kW Dollar Savings	kWh Savings	kWh Dollar Savings (Includes Savings Associated with A/C)	Total Elec Dollar Savings
	Baseline Transformer Losses									Powersmiths Transformer Losses								Annual Savings with Powersmiths							
1	0.49	0.44	4,083	0.94	$0.00	$ 392	-	-	$ -	0.14	0.07	0.21	$0.00	$ 86	-	-	$ -	$ 392	$ 86	0.36	-	$0.00	3,184	$305.71	$305.71
	0.49		4,083	0.94	$0	$392	0.00	0	$0	0.14		0.21	$0.00	$86	0.00	0	$0	$ 392	$ 86	0.36	0.00	$0	3,184	$306	$306

Appendix C – Equipment Cut Sheets

Table of Contents

ALED26



ALED Area Lights mount to 4" square steel poles at 15-20'. 1 to 4 fixtures can be mounted to each pole. IES Full Cutoff, Fully Shielded optics. 5 year Warranty.

Color: Bronze

Weight: 6.5 lbs

Project:	Type:
Prepared By:	Date:

Driver Info		LED Info	
Type:	Constant Current	Watts:	26W
120V:	0.26A	Color Temp:	5000K (Cool)
208V:	0.16A	Color Accuracy:	70 CRI
240V:	0.14A	L70 Lifespan:	100,000
277V:	0.12A	Lumens:	2,662
Input Watts:	30W	Efficacy:	90 LPW
Efficiency:	88%		

Technical Specifications

Listings

UL Listing:

Suitable for wet locations.

IESNA LM-79 & IESNA LM-80 Testing:

RAB LED luminaires have been tested by an independent laboratory in accordance with IESNA LM-79 and 80, and have received the Department of Energy "Lighting Facts" label.

Dark Sky Approved:

The International Dark Sky Association has approved this product as a full cutoff, fully shielded luminaire.

DLC Listed:

This product is on the Design Lights Consortium (DLC) Qualified Products List and is eligible for rebates from DLC Member Utilities.

LED Characteristics

Lifespan:

100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations.

Color Consistency:

7-step MacAdam Ellipse binning to achieve consistent fixture-to-fixture color.

Color Stability:

LED color temperature is warrantied to shift no more than 200K in CCT over a 5 year period.

Color Uniformity:

RAB's range of CCT (Correlated color temperature) follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2015.

Construction

IP Rating:

Ingress Protection rating of IP66 for dust and water.

IES Classification:

The Type IV distribution (also known as a Forward Throw) is especially suited for mounting on the sides of buildings and walls, and for illuminating the perimeter of parking areas. It produces a semiCircular distribution with essentially the same candlepower at lateral angles from 90° to 270°.

Housing:

Precision die cast aluminum housing, lens frame.

Gaskets:

High temperature silicone.

Effective Projected Area:

EPA = 0.27.

Finish:

Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color, and contains no VOC or toxic heavy metals.

Green Technology:

ALEDs are Mercury, Arsenic and UV free.

Ambient Temperature:

Suitable for use in 40°C ambient temperatures.

Cold Weather Starting:

The minimum starting temperature is -40°F/-40°C.

Thermal Management:

Cast aluminum Thermal Management system for optimal heat sinking. The ALED is designed for cool operation, most efficient output and maximum LED life by minimizing LED junction temperature.

Other

Warranty:

RAB warrants that our LED products will be free from defects in materials and workmanship for a period of five (5) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish.

California Title 24:

See ALED26/PC for a 2013 California Title 24 compliant model.

Equivalency:

The ALED26 is Equivalent in delivered lumens to a 70 W Metal Halide Area Light.

HID Replacement Range:

The ALED26 can be used to replace 42 CFL - 100W Metal Halide Area Light based on delivered lumens.

Patents:

The ALED design is protected by U.S. PATENT D608,040 and patents pending in the U.S., Canada, China, Taiwan and Mexico.

Country of Origin:

Designed by RAB in New Jersey and assembled in Taiwan.

Trade Agreements Act Compliant:

This product is a product of Taiwan and a "designated country" end product that complies with the Trade Agreements Act.

GSA Schedule:

Suitable in accordance with FAR Subpart 25.4.

Technical Specifications (continued)

Optical

Lumen Maintenance:

The LED will deliver 70% of its initial lumens at 100,000 hours of operation.

BUG Rating:

B1 U0 G0

Electrical

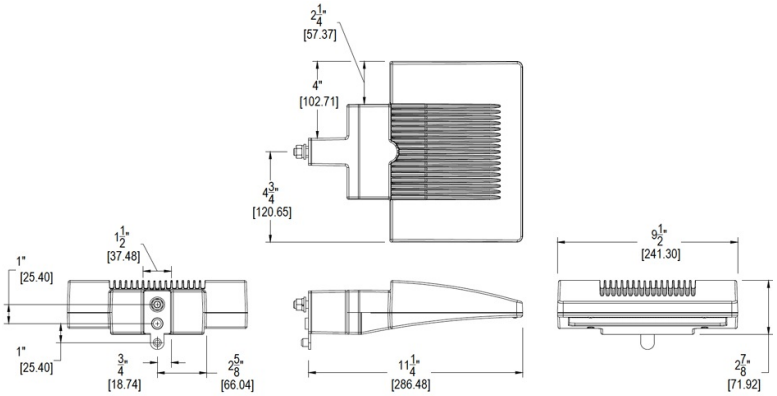
Driver:

Multi-chip 26W high output long life LED Driver Constant Current, 720mA, Class 2, 6kV Surge Protection, 100V-277V, 50-60 Hz, 100-240V.4 Amps.

THD:

7.5% at 120V, 11% at 277V

Dimensions



Features

- High output LED light engine
- Maintains 70% of initial lumens at 100,000 hours
- Weatherproof high temperature silicone gaskets
- Superior heat sinking with die cast aluminum housing and external fins

Ordering Matrix

Family	Watts	Color Temp	Finish	Photocell	Dimming
ALED					
	26 = 26W	= Cool **Y** = Warm **N** = Neutral	= Bronze **W** = White	= No Photocell **/PC** = 120V Button **/PC2** = 277V Button	= No Dimming **/D10** = Dimmable

ALED5T26W

High output LED pole top area light with IES type V circular distribution. Wide and uniform 360 degree pattern ideal for large outdoor areas such as parking lots, corporate parks, and retail settings.

Color: White

Weight: 21.8 lbs

Project:	Type:
Prepared By:	Date:

Driver Info		LED Info	
Type:	Constant Current	Watts:	26W
120V:	0.30A	Color Temp:	5000K (Cool)
208V:	0.17A	Color Accuracy:	68 CRI
240V:	0.15A	L70 Lifespan:	100,000
277V:	0.13A	Lumens:	2,748
Input Watts:	30W	Efficacy:	93 LPW
Efficiency:	88%		

Technical Specifications

Listings

UL Listing:

Suitable for wet locations.

IESNA LM-79 & LM-80 Testing:

RAB LED luminaires have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80, and have received the Department of Energy "Lighting Facts" label.

LED Characteristics

LEDs:

High-output, long-life LEDs.

Lifespan:

100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations.

Color Consistency:

7-step MacAdam Ellipse binning to achieve consistent fixture-to-fixture color.

Color Stability:

LED color temperature is warrantied to shift no more than 200K in CCT over a 5 year period.

Color Uniformity:

RAB's range of CCT (Correlated Color Temperature) follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2011.

Electrical

Power Factor:

99.1% at 120V

Construction

Cold Weather Starting:

Minimum starting temperature is -40°F / -40°C.

Ambient Temperature:

Suitable for use in 40°C (104°F) ambient temperatures.

Effective Projected Area:

EPA = 1.2

Thermal Management:

Superior heat sinking with external air-flow fins.

Housing:

Precision die-cast aluminum, Type V distribution.

Support Arms:

Extruded aluminum.

Lens:

Clear tempered glass lens.

Reflector:

Specular vacuum-metallized polycarbonate, Type V distribution.

Gaskets:

High-temperature silicone.

Finish:

Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color, and contains no VOC or toxic heavy metals.

Green Technology:

Mercury and UV free, and RoHS compliant.

Other

Patents:

The designs of the ALED5T52 are protected by patents pending in US, Canada, China, Taiwan and Mexico.

Country of Origin:

Designed by RAB in New Jersey and assembled in the USA by RAB's IBEW Local 3 workers.

Buy American Act Compliant:

This product is a COTS item manufactured in the United States, and is compliant with the Buy American Act.

Trade Agreements Act Compliant:

This product is a COTS item manufactured in the United States, and is compliant with the Trade Agreements Act.

GSA Schedule:

Suitable in accordance with FAR Subpart 25.4.

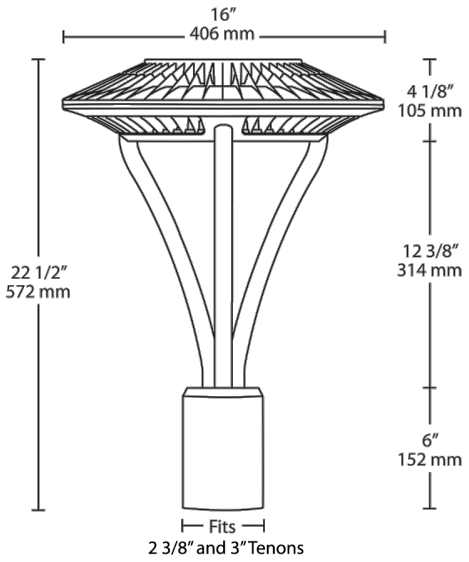
Optical

BUG Rating:

B2 U1 G1

ALED5T26W

Dimensions



Features

- IES type V (circular) distribution
- 100,000-hour LED lifespan
- Compatible with standard 2 3/8" and 3" tenons
- Air-flow fins for maximum heat dissipation
- 5-year warranty

Ordering Matrix

Family	Distribution	Watts	Color Temp	Finish	Dimming	Bi-Level
ALED						
	5T = Type V	**78** = 78W **52** = 52W	= Cool **Y** = Warm **N** = Neutral	= Bronze **W** = White	= No Dimming **/D10** = Dimmable	= No Bi-Level **/BL** = Bi-Level

The right solution

Philips Advance Centium® ballasts for 40W twin tube lamps are the right solution when looking for a lot of light in a small package

When looking for a lot of light in a small convenient package the right solution is Philips Advance Centium® ballasts for 40W twin tube lamps. These instant start ballasts are available with IntelliVolt® technology as well as lamp End-Of-Life (EOL) protection circuitry in an industry standard small can.

Lightweight and compact these ballasts provide flexibility and design versatility making them ideal for use in various types of office applications in the commercial, retail, hospitality and healthcare markets. The instant start feature delivers independent lamp keeping the remaining lamps ON even when one lamp goes out.

These ballasts are compatible with the Philips Energy Advantage PLL 40/25W Lamp as well as the Sylvania 40/28W Dulux L Super Saver lamp.*

* Limitations apply cold starting; please consult Philips Lighting Electronics Product Management prior to using in these applications.

IntelliVolt® technology

- Enhances accuracy and ease of ordering while reducing stocking /SKU requirements

Improved electronic circuitry

- Delivers 7% energy savings over our dedicated ballasts**

Lamp End-Of-Life (EOL) protection circuitry

- Removes power to lamps upon lamp failure

Compact and lightweight housing measuring (9.5"L x 1.7" W x 1.18"H)

- Promotes enhanced versatility and design flexibility

** Based on input watts of Philips Advance's ICN-2TTP40-SC (68 watts) and RCN-2TTP40-SC (72 watts)

PHILIPS
ADVANCE

No. of Lamps	Input Volts	Lamp Starting Method	Ballast Family	Catalog Number	Input Power ANSI (Watts)	Ballast Factor	Max. THD %	Line Current (Amps)	Min. Starting Temp. (°F /°C)	Dim.	Wiring Diag.
FT40W/2G11/RS (40W) - PLL40W, F40BX, FT40DL/RS											
1	120-277	IS	Centium	ICN-1TTP40-SC	39 - 38	0.90	10	0.33 - 0.14	0/-18	B	70*
				ICN-2TTP40-SC	41	1.00		0.35 - 0.15			
2	120-277	IS	Centium	ICN-2TTP40-SC	68 - 67	0.88	10	0.57 - 0.25	0/-18	B	71*
				ICN-3TTP40-SC	73 - 72	0.96		0.61 - 0.27			
3	120-277	IS	Centium	ICN-3TTP40-SC	99 - 97	0.88	10	0.83 - 0.35	0/-18	B	72
FT40W/2G11/ES (PLL 40/25W)											
1	120-277	IS	Centium	ICN-1TTP40-SC	33 -32	0.90	10	0.28 - 0.12	0/-18	B	70*
				ICN-2TTP40-SC	35	1.00		0.29 - 0.13			
2	120-277	IS	Centium	ICN-2TTP40-SC	58 - 57	0.88	10	0.48 - 0.21	0/-18	B	71*
				ICN-3TTP40-SC	60	0.96		0.51 - 0.22			
3	120-277	IS	Centium	ICN-3TTP40-SC	82 - 80	0.88	10	0.67 - 0.29	0/-18	B	72

* Insulate unused blue lead for 600V

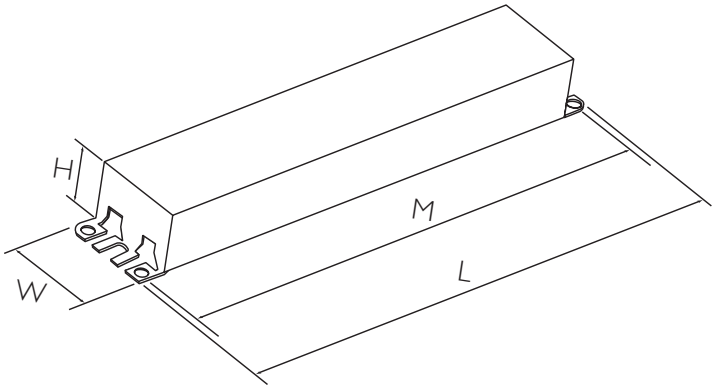


Fig. B

9.5" (L) x 1.7" (W) x 1.18" (H) x 8.9" (M)

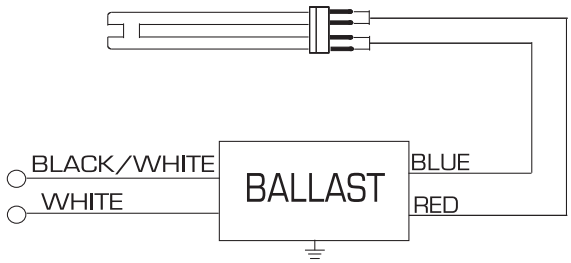


Fig. 70

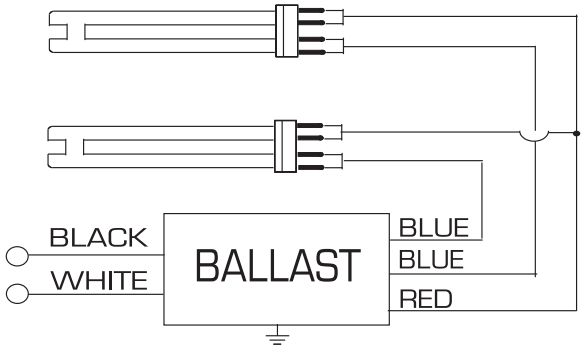


Fig. 71

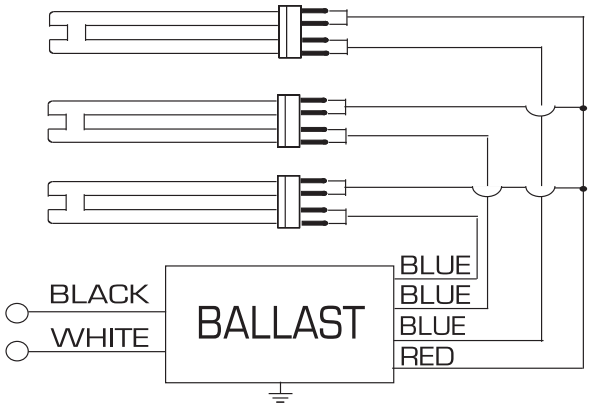


Fig. 72

Ballast Specification for Centium Electronic Fluorescent

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be provided with integral leads color-coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Instant Start.

2.2 Ballast shall provide Independent Lamp Operation (ILO) for Instant Start ballasts allowing remaining lamp(s) to maintain full light output when one or more lamps fail.

2.3 Ballast shall provide lamp EOL protection circuit.

2.4 Ballast shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

2.5 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.6 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.7 Ballast shall have a ballast factor of 0.88 for primary lamp applications.

2.8 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less in accordance with lamp manufacturer recommendations.

2.9 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% for Centium models when operated at normal line voltage with primary lamp.

2.10 Ballast shall have a Class A sound rating.

2.11 Ballast shall have a minimum starting temperature of -18°C (0°F) for Long Twin Tube lamps for primary lamp application.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9002 Quality System Standards.

4.2 Ballast shall carry a _____warranty from date of manufacture against defects in material or workmanship for operation at a maximum case temperature of _____
(Go to our web site for up-to-date warranty information: www.advancetransformer.com/warranty).

4.3 Manufacturer shall have a fifteen-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be Philips Advance part # _____ or approved equal.

Form No. EL-2480-R01 11/08

Philips Lighting Electronics N.A.
10275 W. Higgins Road
Rosemont IL 60018
Tel: 800-322-2086 Fax: 888-423-1882
Customer Support/Technical Service: 800-372-3331
OEM Support: 866-915-5886
www.philips.com/advance

FXLED105T

Ultra high output, high efficiency LED floodlight with wide NEMA type 6H x 6V beam spread. Patent Pending airflow technology ensures long LED and driver lifespan. Use for general and security lighting for large areas, building facades, signs and landscapes.

Color: Bronze

Weight: 25.0 lbs

Project:	Type:
Prepared By:	Date:

Driver Info		LED Info	
Type:	Constant Current	Watts:	105W
120V:	0.89A	Color Temp:	5000K (Cool)
208V:	0.58A	Color Accuracy:	65 CRI
240V:	0.50A	L70 Lifespan:	100,000
277V:	0.44A	Lumens:	10,908
Input Watts:	107W	Efficacy:	102 LPW
Efficiency:	98%		

Technical Specifications

Listings

UL Listing:

Suitable for wet locations. Suitable for ground mounting.

IESNA LM-79 & LM-80 Testing:

RAB LED luminaries have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80, and have been received the Department of Energy "Lighting Facts" label.

DLC Listed:

This product is on the Design Lights Consortium (DLC) Qualified Products List and is eligible for rebates from DLC Member Utilities.

LED Characteristics

Lifespan:

100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations.

LEDs:

Multip-chip, high-output, long-life LEDs

Color Consistency:

7-step MacAdam Ellipse binning to achieve consistent fixture-to-fixture color.

Color Stability:

LED color temperature is warrantied to shift no more than 200K in CCT over a 5 year period.

Color Uniformity:

RAB's range of CCT (Correlated Color Temperature) follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2011.

Construction

IP Rating:

Ingress Protection rating of IP66 for dust and water.

Ambient Temperature:

Suitable for use in 40°C (104°F) ambient temperatures.

Effective Projected Area:

EPA = 2

Cold Weather Starting:

The minimum starting temperature is -40°F/-40°C.

Thermal Management:

Superior thermal management with external Air-Flow fins.

Housing:

Die-cast aluminum housing and door frame

Mounting:

Heavy-duty Trunnion mount with stainless steel hardware

Reflector:

Specular, vacuum-metalized polycarbonate

Gaskets:

High-temperature silicone gaskets

Finish:

Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color, and contains no VOC or toxic heavy metals.

Green Technology:

Mercury and UV free, and RoHS compliant. Polyester powder coat finish formulated without the use of VOC or toxic heavy metals.

Electrical

Drivers:

Two Drivers, Constant Current, Class 2, 1400mA, 100-277V, 50/60Hz, 0.8A, Power Factor 99%

THD:

7.6% at 120V, 15.8% at 277V

Optical

NEMA Type:

NEMA Beam Spread of 6H x 6V

Sensor Characteristics

Field & Beam Angles:

Horizontal Beam Angle (50%): 91.8°, Vertical Beam Angle (50%): 73.5° Horizontal Field Angle (10%): 121.0°, Vertical Field Angle (10%): 108.0°

Other

Warranty:

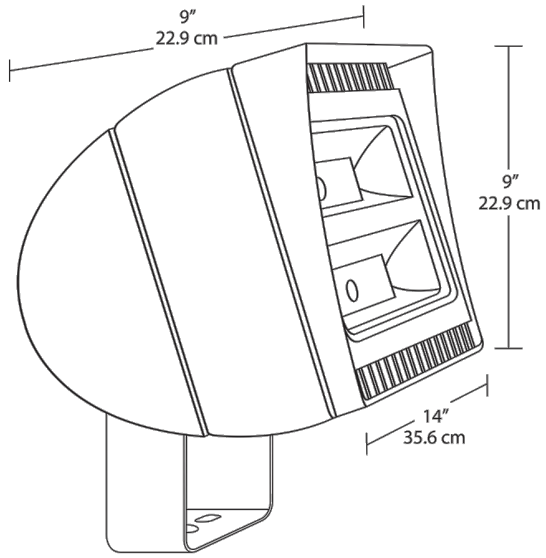
RAB warrants that our LED products will be free from defects in materials and workmanship for a period of five (5) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish.

Patents:

The design of FXLED105 is protected by patents pending in US, Canada, China, Taiwan and Mexico.

FXLED105T

Dimensions



Features

- 66% energy cost savings vs. HID
- NEMA Type - 6H x 6V
- Air-Flow technology heat dissipation
- 100,000-hour LED lifespan
- 5-year warranty

Ordering Matrix

Family	Watts	Mount	Color Temp	Finish	Voltage	Photocell	Bi-Level
FXLED							
	105 = 105W	**T** = Trunnion **SF** = Slipfitter	= Cool **Y** = Warm **N** = Neutral	= Bronze **W** = White	= 120-277V **/480** = 480V	= No Photocell **/PCT** = 120-277V Twistlock Photocell **/PCT4** = 480V Twistlock Photocell	= No Bi-Level **/BL** = Bi-Level

PHILIPS

GARDCO

Site & Area

EcoForm

Project:

Location:

Cat.No:

Type:

Qty:

Notes:

EcoForm combines economy with performance in an LED area luminaire. Capable of delivering up to 20,000 lumens or more in a compact, low profile housing, EcoForm offers a new level of customer value. EcoForm features an innovative retrofit arm kit, simplifying site conversions to LED by eliminating the need to drill additional holes in most existing poles. Integral control systems, including motion response and wireless controls are available for further energy savings during off peak hours.

Ordering guide

example: ECF-APD-MRO-1-4-75LA-NW-120-NP-LF

Prefix	Controls	Mounting	Optics	LED Wattage	Color Temp	Voltage	Finish	Options
ECF -	-	1 -	3 -	135LA -	CW -	UNV -	BRP -	
ECF EcoForm	**—** Standard luminaire (leave blank) **DIM** 0-10V Dimming **APD**[1] Auto Profile Dimming **APD-MRO**[2] Auto Profile Dimming and Motion Response Override pole mounted motion sensor **APD-MRI**[2,3] APD with Motion Response Override luminaire sensor **MRI**[2,3] Motion Response at 50% low luminaire sensor **MR50**[2] Motion Response at 50% low, pole mounted sensor **LimeLight Wireless Controls** **LLC2**[1,5] #2 lens for 8-15' mounted heights **LLC3**[1,5] #3 lens for 15-25' mounted heights **LLC4**[1,5] #4 lens for 25-40' mounted heights	**1** Standard **2** 2@180 **2@90** 2@90 **3** 3@90 **3@120** 3@120 **4** 4@90 **WS** Wall mount including surface conduit rear entry permitted **MA** Mast Arm Fitter (requires 2-3/8" O.D. Mast Arm)	**2** Type 2 **3** Type 3 **4** Type 4 **5** Type 5	**530 mA** **55LA-3253**[1] **75LA-4853** **100LA-6453** **700mA** **70LA-3270** **105LA-4870** **135LA-6470** **1050mA** **105LA-321A**[1] **160LA-481A** **215LA-641A**	**CW** Cool White 5,700 K 70 CRI (nominal) **NW** Neutral White 4,000 K 70 CRI (nominal) **WW**[4] Warm White 3,000 K 70 CRI (nominal)	**120** 120V **208** 208V **240** 240V **277** 277V **347** 347V **480** 480V **UNV** 120-277V 50hz/60hz **HVU** 347-480V 50hz/60hz	**BRP** Bronze Paint **BLP** Black Paint **WP** White Paint **NP** Natural Paint **OC** Optional Color Specify optional color or RAL (ex: OC-LGP or OC-RAL7024) **SC** Special color Specify, must supply color chip. Requires factory quote.	**TL** Tool-Less entry and driver removal hardware **TB**[3] Terminal Block **IS**[6] Internal Shield **LF**[7] Line Fusing **LFC**[7] Line Fusing for Canada **PC**[5,7,8] Receptacle with Photocell (Includes PCR5) **PCB**[5,7,8] Photocell Button **PCR5**[5,11,13] Photocell Receptacle only with 2 dimming connections **PCR7**[5,12,13] Photocell Receptacle only with 2 dimming and 2 auxiliary connections **RAM** Retrofit Arm Mount kit **PTF2**[9] Pole Top Fitter for 2 3/8"- 3" Tenon **PTF3**[9] Pole Top Fitter for 3"- 3 1/2" Tenon **PTF4**[9] Pole Top Fitter for 3 1/2"- 4" Tenon **RPA**[10] Round Pole Adapter for 3"- 3.9" O.D. **BD** Bird Deterrent (field installed only)

1. Available in 120V–277V Voltages only (UNV, 120, 208, 240 & 277).
2. MR50 and APD-MRO luminaires require one motion sensor per pole, ordered separately. See page 2 for Accessories. Available in 120V or 277V only.
3. ECF-MRI requires outboarded sensor when used with Terminal Block (TB) Option.
4. Contact factory for lead times on warm white.
5. LLC2/LLC3/LLC4 Wireless Controls are not configurable with PC/PCB/PCR5/PCR7 Options. See page 7-8 for more info.
6. Not configurable with Type 5 (5) Optics.
7. Not configurable with 120-277V (UNV) Voltage. Voltage must be specified.
8. Not configurable with 480V (480) Voltage.
9. Not configurable with 3@120 (3@120) Mounting.
10. No adaptor required for 4" round poles. RPAs provided with Black Paint standard.
11. Works with 3-pin or 5-pin NEMA photocell/dimming device.
12. Works with 3-pin or 5-pin NEMA photocell/dimming device and auxiliary connections are not connected (for future use only).
13. If ordered with DIM, APD, MRI, MR50, APD-MRI, APD-MRO, dimming will not be connected to NEMA receptacle.

ECF EcoForm

Site & Area

EcoForm Accessories (order separately)

FS1R-100

MR hand held programmer

For use with 'MRI' motion response when field programming is required. If desired, only one is needed per job.

MS-A-120V

120V Input Area Motion Sensor

For MR50 (Motion Response) or APD-MRO (Automatic Profile Dimming with Motion Response Override)

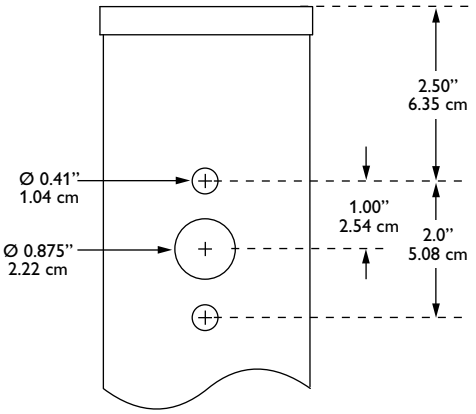
MS-A-277V

277V Input Area Motion Sensor

For MR50 (Motion Response) or APD-MRO (Automatic Profile Dimming with Motion Response Override)

Note: Motion Sensors are ordered separately, with one (1) motion sensor required per pole location for MR50 or APD-MRO luminaires. See Luminaire Configuration Information on page 5 for more details. Area motion sensor color is Arctic White. MRI and APD-MRI luminaires include an integral motion sensor.

EcoForm Drill Template (standard arm mount)



LED Wattage and Lumen Values (standard EcoForm luminaire)

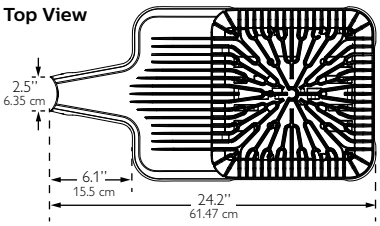
Order Code (standard units)	Array Quantity	Total LEDs	LED Current (mA)	Average System Watts[1]	LED Selection	Initial Lumens[2]			
						2 Type 2	3 Type 3	4 Type 4	5 Type 5
55LA-3253	2	32	530	52	NW	5,994 (s)	5,895 (s)	5,823 (s)	5,588 (s)
75LA-4853	3	48	530	77	NW	8,899 (s)	8,753 (s)	8,646 (s)	8,297 (s)
100LA-6453	4	64	530	103	NW	11,896 (s)	11,700	11,558	11,091
70LA-3270	2	32	700	69	NW	7,385 (s)	7,576 (s)	7,293 (s)	7,068 (s)
105LA-4870	3	48	700	104	NW	10,965 (s)	11,249 (s)	10,828 (s)	10,494 (s)
135LA-6470	4	64	700	139	NW	14,657 (s)	15,037	14,475 (s)	14,028
105LA-321A	2	32	1050	107	NW	10,199 (s)	10,458	10,072 (s)	9,767
160LA-481A	3	48	1050	158	NW	15,144 (s)	15,565	14,955 (s)	14,465
215LA-641A	4	64	1050	211	NW	20,243	20,252	19,991	19,880

1. System input wattage may vary based on input voltage, by up to +/- 10% , and based on manufacturer forward voltage, by up to +/- 8%.
2. Lumen values based on photometric tests performed in compliance with IESNA LM-79.

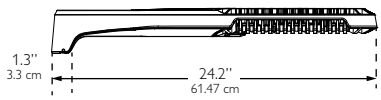
(s). Data is scaled based on tests of similar, but not identical, luminaires.

Dimensions – Standard EcoForm luminaire

Top View



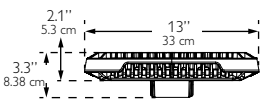
Side View



EPA (ft^2/m^2)

Single	Twin (2@180)	3/4@90
0.2 / 0.019	0.5 / 0.046	0.5 / 0.046

End View



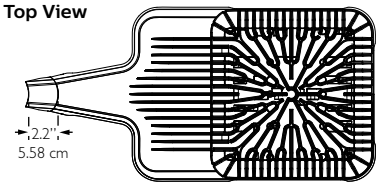
Approximate Luminaire Weight:
20 Lbs (9.07 Kg)

ECF EcoForm

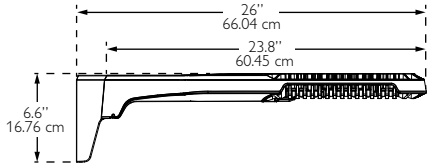
Site & Area

Dimensions – EcoForm with Retrofit Arm Mount (RAM)

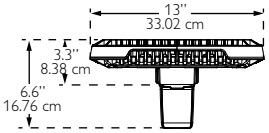
Top View



Side View



End View



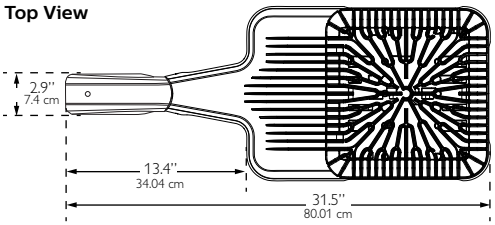
EPA (ft^2/m^2)

Single	Twin (2@180)	3/4@90
0.3 / 0.028	0.6 / 0.056	0.7 / 0.065

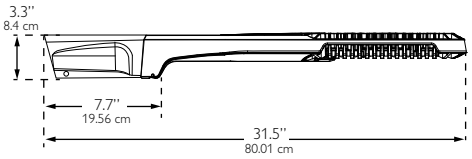
Approximate Luminaire Weight:
21 Lbs (9.53 Kg)

Dimensions – EcoForm with Mast Arm Fitter (MA)

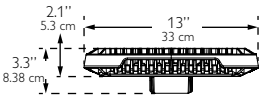
Top View



Side View



End View



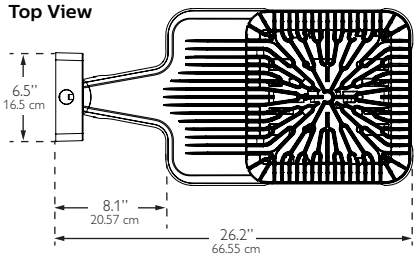
EPA (ft^2/m^2)

Single
0.51 / 0.047

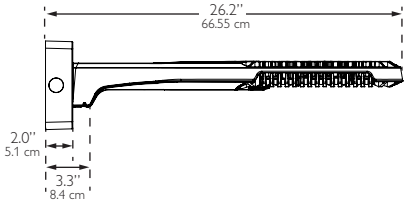
Approximate Luminaire Weight:
21.5 Lbs (9.77 Kg)

Dimensions – EcoForm with Wall Mount (WS)

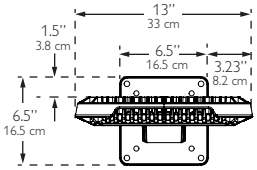
Top View



Side View



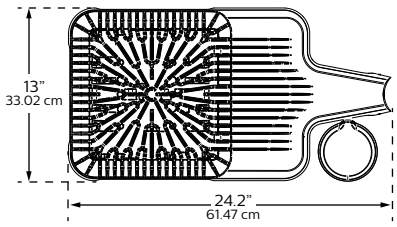
End View



Approximate Luminaire Weight:
23.36 Lbs (10.6 Kg)

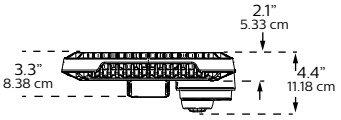
Dimensions – EcoForm with LimeLight Luminaire mounted controller

Top View



Side View

End View



ECF EcoForm

Site & Area

Luminaire Configuration Information

ECF

Philips Gardco EcoForm LED standard luminaire providing constant wattage and constant light output when power to the luminaire is energized.

ECF-DIM

Philips Gardco EcoForm LED luminaire provided with 0-10V dimming for connection to a control system provided by others.

ECF-APD

Philips Gardco EcoForm LED luminaire with Automatic Profile Dimming. Luminaire is provided with a Philips DynaDimmer module, programmed to go to 50% power, 50% light output two (2) hours prior to night time mid-point and remain at 50% for six (6) hours after night time mid-point. Mid-point is continuously recalculated by the Philips DynaDimmer module based on the average mid-point of the last two full night cycles. Short duration cycles, and power interruptions are ignored and do not affect the determination of mid-point.

ECF-APD is available in 120V–277V input only.

ECF-APD Dimming Profile:

100%	2 hours	6 hours	100%
	50%	50%	

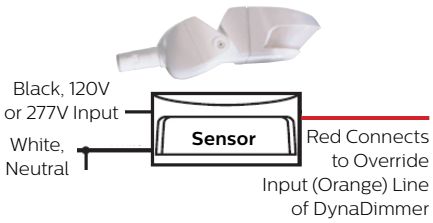
Power On **Mid Point** **Power Off**

ECF-MR50

Philips Gardco EcoForm LED luminaire with motion response, providing a 50% power reduction on low and a commensurate reduction in light output. The power and light output reduction is accomplished utilizing the Philips DynaDimmer module, programmed for a constant 50% power. Power supplied by the motion sensor connected to the override line on the DynaDimmer takes the luminaire to high setting, 100% power and light output, when motion is detected. The luminaire remains on high until no motion is detected for the motion sensor duration period, after which the luminaire returns to low. Duration period is factory set at 15 minutes, and is field adjustable from 5 minutes up to 15 minutes.

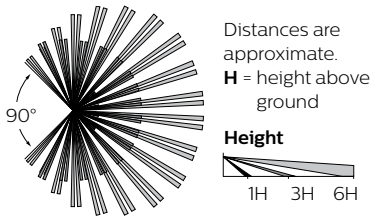
ECF-MR50 is available in 120V–277V input only to the luminaire. Motion sensors require single voltage 120V or 277V input.

The Area PIR motion sensor is the WattStopper EW-200-120-W (120V Input - MSA-120V) or the WattStopper EW-200-277-W (277V Input - MSA-277V.) One motion sensor per pole is required and is ordered separately. Area sensors require single voltage 120V or 277V input.



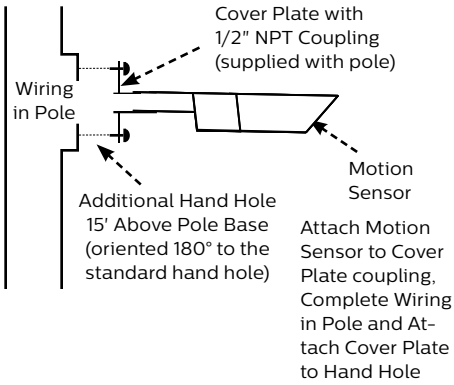
The area motion detector provides coverage equal to up to 6 times the sensor height above ground, 270° from the front-center of the sensor.

Area PIR Motion Sensor Coverage Pattern:



Motion response requires that the pole include an additional hand hole 15 feet above the pole base, normally oriented 180° to the standard hand hole. For Philips Gardco poles, order the pole with the Motion Sensor Mounting (MSM) option which includes the hand hole and a special hand hole cover plate for the sensor with a 1/2" NPT receptacle centered on the hand hole cover plate into which the motion sensor mounts. Once the motion sensor is connected to the hand hole cover plate, then wiring connections are completed in the pole. The plate (complete with motion sensor attached and wired) is then mounted to the hand hole. If poles are supplied by others, the customer is responsible for providing suitable mounting accommodations for the motion sensor in the pole.

Mounting to a Philips Gardco Pole:



ECF-APD-MRO

Philips Gardco EcoForm LED luminaire with Automatic Profile Dimming, with Motion Response Override. The ECF-APD-MRO combines the benefits of both automatic profile dimming and motion response, using the Philips DynaDimmer module. The luminaire will dim to 50% power, 50% light output, per the dimming profile shown for the ECF-APD. If motion is detected during the time that the luminaire is operating at 50%, the luminaire returns to 100% power and light output. The luminaire remains on high until no motion is detected for the duration period, after which the luminaire returns to low. Duration period is factory set at 15 minutes, and is field adjustable from 5 minutes up to 15 minutes.

Notes:

ECF-APD-MRO is available in 120V through 277V input only to luminaire. The motion sensor requires either 120V or 277V input to the motion sensor.

The ECF-APD-MRO has the same pole requirements and utilizes the same motion sensors as the ECF-MR50. The motion sensor mounts and wires identically as well. The ECF-APD-MRO utilizes the identical dimming profile as shown for the ECF-APD.

By combining the benefits of automatic profile dimming and motion response, the ECF-APD-MRO assures maximum energy savings, and insures that adequate light is present if motion is detected.

All motion sensors utilized consume 0.0 watts in the off state.

Luminaire Configuration Information (Continued)

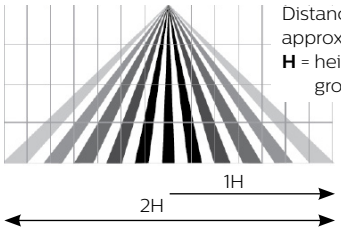
ECF-MRI

Luminaires with Motion Response include a LED driver and an integral programmable motion sensor. The motion sensor is set to a constant 50%. When motion is detected, the luminaire goes to 100%. The luminaire remains on high until no motion is detected for the motion sensor duration period, after which the luminaire returns to low. Duration period is factory set at 5 minutes. Available with 120V or 277V only.

Luminaires include a passive infrared (PIR) motion sensor, WattStopper® FSP-211 equipped with an FSP-L3 lens, capable of detecting motion within 20 feet of the sensor, 180° around the luminaire, when placed at a 20 foot mounting height, or mounted on a wall. Available in 120V or 277V input only. Motion sensor off state power is 0.0 watts.

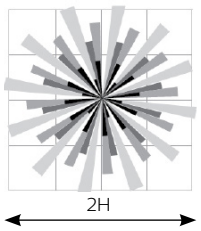
The approximate motion sensor coverage pattern is as shown below.

Side Coverage Pattern



Distances are approximate.
H = height above ground

Top Coverage Pattern



ECF-APD-MRI

Luminaires with Automatic Profile Dimming and Motion Response Override combine the benefits of both automatic profile dimming and motion response. APD-MRI luminaires utilize Philips DynaDimmer. The luminaire will dim to 50% power, 50% light output, per the dimming profile shown for APD luminaires (see page 4). If motion is detected during the time that the luminaire is operating at 50%, the luminaire goes to 100% power and light output. The luminaire remains on high until no motion is detected for the duration period, after which the luminaire returns to low. Duration period is factory set at 5 minutes.

APD-MRI luminaires are available with 120V or 277V input voltages only.

APD-MRI luminaires use the identical motion sensor as MRI luminaires. See motion sensor details for ECF-MRI.

FS1R-100 Wireless Remote Programming Tool

The FS1R-100 Remote Programming Tool accessory permits adjustment of ECF-MRI and ECF-APD-MRI sensor settings, including duration and dimming level on low, without the need to connect any wires to the luminaire.

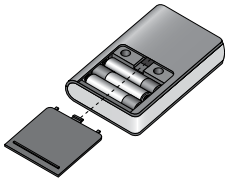
The FS1R-100 Wireless IR Programming Tool is a handheld tool for setup and testing of WattStopper FSP-211. It provides wireless access to the FSP-211 sensors for setup and parameter changes.

The FS1R-100 display shows menus and prompts to lead you through each process. The navigation pad provides a familiar way to navigate through the customization fields.

Within a certain mounting height of the sensor, the FS1R-100 allows modification of the system without requiring ladders or tools simply with a touch of a few buttons.

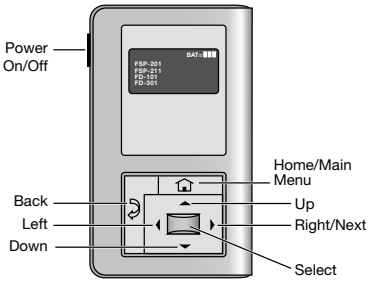
The FS1R-100 IR transceiver allows bi-directional communication between the FSP-211 and the FS1R-100 programming tool . Simple menu screens let you see the current status of the system and make changes. It can change FSP-211 sensor parameters such as high/low mode, sensitivity, time delay, cut off and more. With the FS1R-100 you can also establish and store FSP-211 parameter profiles.

The FS1R-100 operates on three standard 1.5V AAA Alkaline batteries or three rechargeable AAA NiMH batteries. The battery status displays in the upper right corner of the display. Three bars next to BAT= indicates a full battery charge. A warning appears on the display when the battery level falls below a minimum acceptable level. To conserve battery power, the FS1R-100 automatically shuts off 10 minutes after the last key press.



You navigate from one field to another using (up) or (down) arrow keys. The active field is indicated by flashing (alternates between yellow text on black background and black text on yellow background.)

Once active, use the Select button to move to a menu or function within the active field. Value fields are used to adjust parameter settings. They are shown in “less-than/greater-than” symbols: <value>. Once active, change them using (left) and (right) arrow keys. In general the up key increments and the down key decrements a value. Selections wrap-around if you continue to press the key beyond maximum or minimum values. Moving away from the value field overwrites the original value. The Home button takes you to the main menu. The Back button can be thought of as an undo function. It takes you back one screen. Changes that were in process prior to pressing the key are lost.More information on the FS1R-100 Remote Programming Tool is available at wattstopper.com.



ECF EcoForm

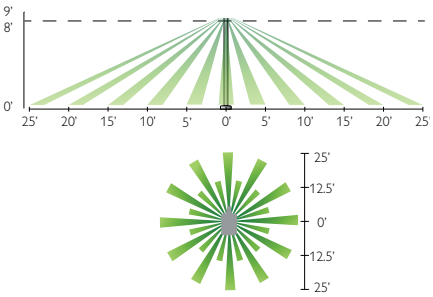
Site & Area

Luminaire Configuration Information – EcoForm with LimeLight

ECF-LLC2

EcoForm with Limelight wireless technology

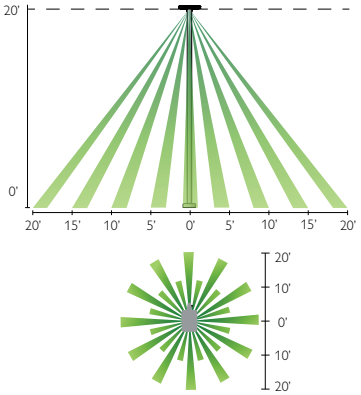
Controller pod attached to luminaire arm and includes radio, photocell and motion sensor with #2 lens for 8-15' mounting heights.



ECF-LLC3

EcoForm with Limelight wireless technology

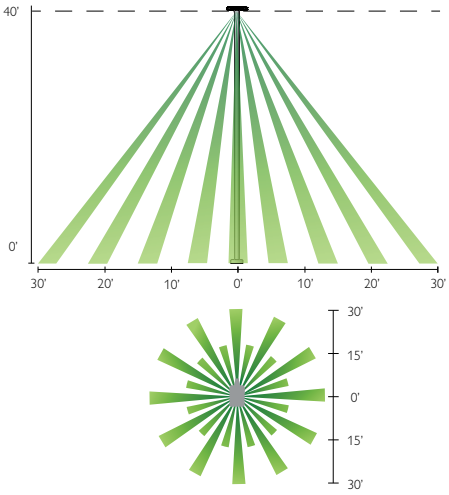
Controller pod attached to luminaire arm and includes radio, photocell and motion sensor with #3 lens for 15-25' mounting heights.



ECF-LLC4

EcoForm with Limelight wireless technology

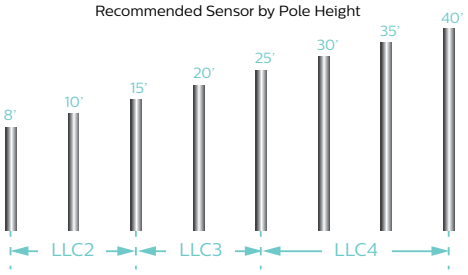
Controller pod attached to luminaire arm and includes radio, photocell and motion sensor with #4 lens for 25-40' mounting heights.



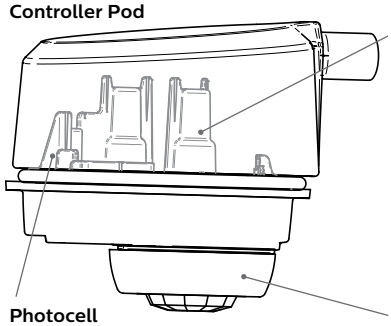
Luminaire Configuration Information – EcoForm with LimeLight

ECF-LLC(#)

With this configuration, the controller pod is mounted to the luminaire arm. One controller is required per luminaire. There are three different motion sensor configurations available. Each one corresponds to the desired mounting height that for your specific application. See motion response detection ranges below.



Controller Pod



Photocell

- Ambient light photocell on every wireless radio that averages the light levels of up to 5 controllers for an accurate reading and optimal light harvesting activity.
- Reports ambient light readings to 1500 Fc.

Wireless Radio

- 1.8 Watts max (no load draw)
- Operating voltage 102-277V RMS
- Communicates using the ZigBee protocol
- Carries out dimming commands from gateway
- Reports internal PCB temperature
- Transmission Systems Operating within the band 2400-2483.5Mhz. IEEE 802.15.4
- ROHS Compliant

Motion Response

- Three different lens configurations
- Detects motion through passive InfraRed sensing technology
- Connects directly to radio through modular jack
- Three different mounting heights and detecion ranges available

Luminaire Configuration Information – EcoForm with LimeLight (Continued)

Gateway

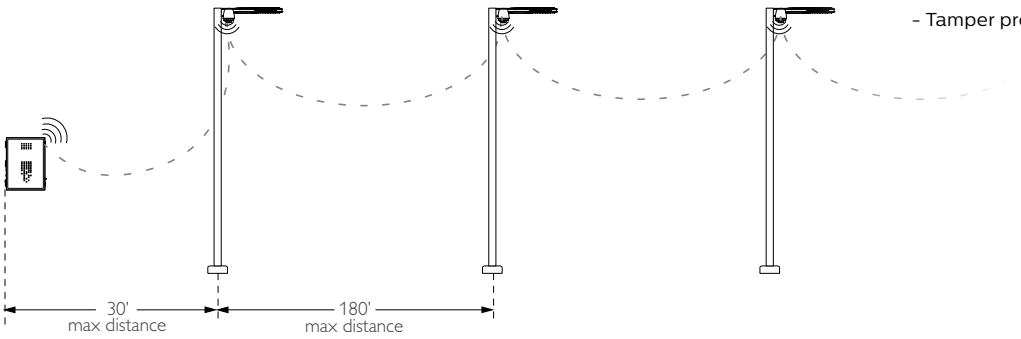
Overview: One gateway is included with the wireless controls system. The gateway opens up communication with the wireless radios installed with the EcoForm luminaires (or pole), allowing you to control your fixtures straight from the web. One LimeLight gateway can communicate with up to 800 fixtures. Typically one unit is required per parking lot.

Installation: Gateway has 4 blind threaded holes on the back side that accept 10-32 screws. Mount spacing is 10.41" across and 14.19" vertical.

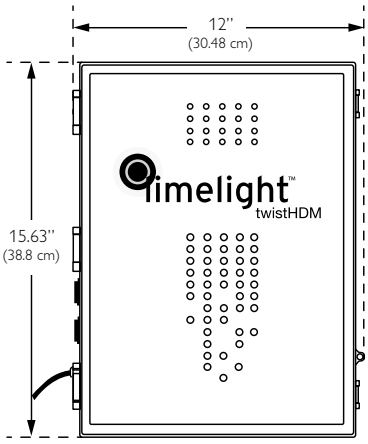
Requirements: The gateway must be mounted in a secure on-site location. The gateway requires 120V. Distance of gateway to the first radio varies upon application; contact factory. Strong internet connection required.

Specifications:

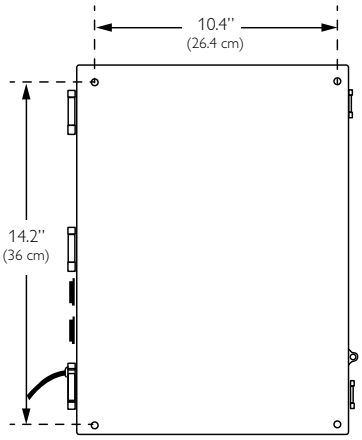
- High density RF Mesh coordinator
- Ethernet or wireless internet connection to LimeLight server
- Proprietor of software "rules of operation"
- Watertight Ethernet connections
- Highly protected, long life ac/dc power supply
- Single board, ARM compliant 520Mhz Intel computer.
- Operating Temperature -20°C to 55°C
- Tamper proof housing



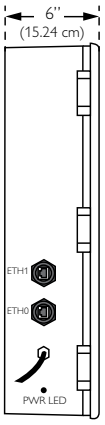
Front View



Back View



Side View



ECF EcoForm

Site & Area

Specifications

Housing

One piece die cast aluminum housing with integral arm and separate,self retained hinged, one piece die cast door frame.

IP Rating

LED light engine rated IP66.

Vibration Resistance

EcoForm with Standard Arm carries a 3G vibration rating that conforms to standards set forth by ANSI C136.31. Testing includes vibration to 3G acceleration in three axes, all performed on the same luminaire.

Electrical

Driver efficiency (>90% standard). 120-480V available (restrictions apply). Open/short circuit protection. Optional 0-10V dimming to 10% power. RoHS compliant. Surge protector standard. 10KA per ANSI/IEEE C62.41.2.

LED Board and Array

32, 48, or 64 LEDs. Color temperatures: 3000K, 4000K, 5700K +/- 250K. Minimum CRI of 70. Aluminum metal clad board. RoHS compliant.

LED Thermal Management

The housing design allows the one piece housing to provide excellent thermal management critical to long LED system life.

Energy Saving Benefits

System efficacy up to 95 lms/W with significant energy savings over Pulse Start Metal Halide luminaires. Optional control options provide added energy savings during unoccupied periods.

Wireless Controls

The LimeLight wireless Controls System includes: gateway, controller pod (with wireless radio, motion response, and photocell), and commissioning/training. LimeLight is an intelligent web-based system that operates through a high density mesh (HDM) wireless technology. Wireless radios with motion response and photocell sensors are integrated with PureForm luminaires, and enable the fixtures to communicate via the ZigBee protocol. The gateway is a mini computer that connects to the internet, and is located in a secure location. The central LimeLight database channels communication to and from the gateway, allowing data to be viewed or managed through the web-based graphical user interface (GUI). See LimeLight pages for details and technical information.

Motion Sensors

ECF-MR50, ECF-APD-MRO, ECF-MRI, ECF-APD-MRI luminaires may be specified for additional energy savings during unoccupied periods. See pages 4-6 for complete details.

Optical Systems

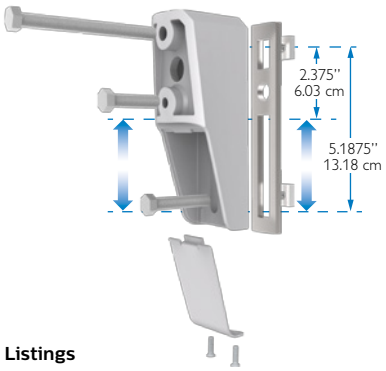
Type 2, 3, 4, and 5 distributions available. Internal Shield option mounts to LED optics and is available with Type 2, 3, and 4 distributions to control backlight.

Mounting

Standard luminaire arm mounts to 4" round poles. Square pole adapter included with every luminaire. Round Pole Adapter (RPA) required for 3-3.9" poles.

Retrofit Arm Mount

EcoForm features an innovative retrofit arm kit. When specified with the retrofit arm (RAM) option, EcoForm seamlessly simplifies site conversions to LED by eliminating the need for additional pole drilling on most existing poles. RAM will be boxed separately.



Listings

ETL/cETL listed to the UL 1598 standard, suitable for Wet Locations. Suitable for use in ambients from -40° to 40°C (-40° to 104°F). The quality systems of this facility have been registered by UL to the ISO 9001 series standards. All EcoForm luminaires equipped with NW and CW are DesignLights Consortium® qualified.

Finish

Each standard color luminaire receives a fade and abrasion resistant, electrostatically applied, thermally cured, triglycidal isocyanurate (TGIC) textured polyester powdercoat finish. Standard colors include bronze (BRP), black (BLP), white (WP), and natural aluminum (NP). Consult factory for specs on optional or custom colors.

Warranty

EcoForm luminaires feature a 5 year limited warranty. Philips Gardco LED luminaires with LED arrays feature a 5 year limited warranty covering the LED arrays. LED Drivers also carry a 5 year limited warranty. Motion sensors are covered by warranty for 5 years by the motion sensor manufacturer.

LED Performance

Predicted Lumen Depreciation Data[1]				
Ambient Temperature °C	**Driver** (mA)	**Calculated L_{70} Hours[1,2]**	**L_{70} Per TM-21[2,3]**	**Lumen Maintenance % @ 60,000 hours**
Up to 40 °C	Up to 1050 mA	> 350,000 hours	> 60,000 hours	97%

1. Predicted performance derived from LED manufacturer's data and engineering design estimates, based on IESNA LM-80 methodology. Actual experience may vary due to field application conditions.
2. L70 is the predicted time when LED performance depreciates to 70% of initial lumen output.
3. Calculated per IESNA TM21-11. Published L70 hours limited to 6 times actual LED test hours.

Philips Lighting, North America Corporation
200 Franklin Square Drive, Somerset, NJ 08873
Tel. 855-486-2216

Imported by: Philips Lighting,
A division of Philips Electronics Ltd.
281 Hillmount Rd, Markham, ON, Canada L6C 2S3
Tel. 800-668-9008

PHILIPS

LED

InstantFit LED T8 Lamps

Easily upgrade to LED from fluorescent.

Philips InstantFit LED T8 and PL-L Lamps are an ideal energy saving choice for existing fluorescent fixtures.

Perfect for a wide range of applications

- Full light output in spaces with temperatures down to -4˚F (-20˚C)
- Perfect for applications with frequent “on/off” switching cycles
- Buildings that desire to be mercury free

Easy to experience

- Compatible with a wide range of ballasts that include instant-start and programmed-start; select models are compatible with dimming ballasts[1]
- Fits into existing linear fixtures
- Eliminates the need for rewiring and allows the fixture to maintain original UL and CSA compliance[2]

Energy savings

- 50% energy savings vs F32T8 electronic instant start systems[3]

Sustainable lighting solution

- No mercury allowing for non-hazardous waste disposal
- Emits virtually no UV rays or IR
- NSF Certified for use in food areas and refrigerated food displays
- 5-year limited warranty[4]

Footnotes on the page 3.

Philips InstantFit LED T8 Lamps

Ordering, Electrical and Technical Data (Subject to change without notice)

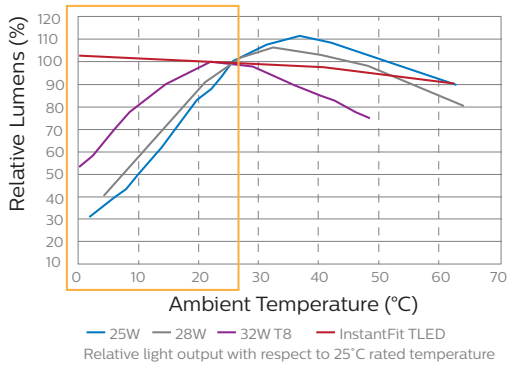
	Product No.	Model No.	Ordering Code	Volts (Depending on Ballast)	Base	CRI	Color Temp. (K)	Pkg Qty	Rated Avg. Life[5]	MOL (In.)	Beam Angle
	LED InstantFit T8 - 4'										
	45358-9	9290011239	12T8/48-3000 IF 10/1	120-277, 347	G13	82	3000	10	50,000	48	160
●	45359-7	9290011240	12T8/48-3500 IF 10/1	120-277, 347	G13	82	3500	10	50,000	48	160
●	45360-5	9290011241	12T8/48-4000 IF 10/1	120-277, 347	G13	82	4000	10	50,000	48	160
●	45361-3	9290011242	12T8/48-5000 IF 10/1	120-277, 347	G13	82	5000	10	50,000	48	160
	LED InstantFit T8 - 4' Dimmable[1] High Output										
●	45689-7	9290011585	15T8/48-3000 IF DIM 10/1	120-277, 347	G13	82	3000	10	50,000	48	160
●	45690-5	9290011586	15T8/48-3500 IF DIM 10/1	120-277, 347	G13	82	3500	10	50,000	48	160
●	45691-3	9290011587	15T8/48-4000 IF DIM 10/1	120-277, 347	G13	82	4000	10	50,000	48	160
●	45692-1	9290011588	15T8/48-5000 IF DIM 10/1	120-277, 347	G13	82	5000	10	50,000	48	160
	LED InstantFit T8 - 4' Glass										
	45656-6	9290011511	17T8/48-4000 IFG 10/1	120-277, 347	G13	82	4000	10	36,000	48	240
	45657-4	9290011512	17T8/48-5000 IFG 10/1	120-277, 347	G13	82	5000	10	36,000	48	240
	LED InstantFit T8 - 3'										
	45205-2	9290011183	10.5T8/36-3000 IF 10/1	120-277, 347	G13	82	3000	10	50,000	36	160
	45206-0	9290011184	10.5T8/36-3500 IF 10/1	120-277, 347	G13	82	3500	10	50,000	36	160
	45207-8	9290011185	10.5T8/36-4000 IF 10/1	120-277, 347	G13	82	4000	10	50,000	36	160
	45208-6	9290011186	10.5T8/36-5000 IF 10/1	120-277, 347	G13	82	5000	10	50,000	36	160
	LED InstantFit T8 - 2' High Output										
	45201-1	9290011179	8.5T8/24-3000 IF 10/1	120-277, 347	G13	82	3000	10	50,000	24	160
●	45202-9	9290011180	8.5T8/24-3500 IF 10/1	120-277, 347	G13	82	3500	10	50,000	24	160
●	45203-7	9290011181	8.5T8/24-4000 IF 10/1	120-277, 347	G13	82	4000	10	50,000	24	160
●	45204-5	9290011182	8.5T8/24-5000 IF 10/1	120-277, 347	G13	82	5000	10	50,000	24	160
	LED InstantFit T8 U-Bent - 6" High Output										
	45266-4	9290011196	16.5T8/22.5-3000 IF-6U 10/1	120-277, 347	G13	82	3000	10	50,000	22.5	160
	45267-2	9290011197	16.5T8/22.5-3500 IF-6U 10/1	120-277, 347	G13	82	3500	10	50,000	22.5	160
	45268-0	9290011198	16.5T8/22.5-4000 IF-6U 10/1	120-277, 347	G13	82	4000	10	50,000	22.5	160
	45269-8	9290011199	16.5T8/22.5-5000 IF-6U 10/1	120-277, 347	G13	82	5000	10	50,000	22.5	160
	LED InstantFit PL-L - 2' High Output										
	45663-2	9290011513	16.5PL-LED/24-3000 IF 10/1	120-277	2G11	82	3000	10	40,000	22.5	160
	45664-0	9290011514	16.5PL-LED/24-3500 IF 10/1	120-277	2G11	82	3500	10	40,000	22.5	160
	45665-7	9290011515	16.5PL-LED/24-4000 IF 10/1	120-277	2G11	82	4000	10	40,000	22.5	160

Ballast Compatibility Guide

Please refer to www.philips.com/instantfit for instant start ballasts details and the latest ballast compatibility guide.

Relative Light Output vs. Ambient Temperature

4' T8 Lamps - 0.88 BF Ballast



Relative light output with respect to 25°C rated temperature

Suitable for use in fixtures where ambient temperature is between -4°F (-20°C) and 113°F (45°C).

Warning: Philips LED T8 InstantFit lamps will only operate properly on compatible Instant-start and Programmed-start ballasts. Please refer to the Philips LED T8 InstantFit Installation Guide, which can be obtained through your local Philips Sales Representative, or visit www.philips.com/instantfit

FCC Note: This device complies with Part 18 of the FCC Rules.

Philips InstantFit LED T8 Lamps

Ordering, Electrical and Technical Data (Subject to change without notice)

Product No.	Bare Lamp Watts (W)	Average System Watts (W)			Initial Lumens[6]		
		Low Ballast Factor (0.78)	Normal Ballast Factor (0.88)	High Ballast Factor (1.18)	Low Ballast Factor (0.78)	Normal Ballast Factor (0.88)	High Ballast Factor (1.18)
LED InstantFit T8 - 4'							
45358-9	12	12.5	14.5	18.5	1300	1500	1700
45359-7	12	12.5	14.5	18.5	1300	1500	1800
45360-5	12	12.5	14.5	18.5	1400	1600	1850
45361-3	12	12.5	14.5	18.5	1450	1650	2000
LED InstantFit T8 - 4' Dimmable[1] High Output							
45689-7	15	16	18	26.5	1800	2000	2700
45690-5	15	16	18	26.5	1800	2000	2700
45691-3	15	16	18	26.5	1900	2100	2800
45692-1	15	16	18	26.5	1900	2100	2800
LED InstantFit T8 - 4' Glass							
45656-6	17	18.0	20.0	26.5	1850	2100	2450
45657-4	17	18.0	20.0	26.5	1850	2100	2450
LED InstantFit T8 - 3'							
45205-2	10.5	12.5	13	17	1000	1100	1330
45206-0	10.5	12.5	13	17	1050	1160	1400
45207-8	10.5	12.5	13	17	1080	1200	1440
45208-6	10.5	12.5	13	17	1150	1270	1550
LED InstantFit T8 - 2' High Output							
45201-1	8.5	10	10.5	14.5	860	950	1110
45202-9	8.5	10	10.5	14.5	900	1040	1170
45203-7	8.5	10	10.5	14.5	930	1050	1200
45204-5	8.5	10	10.5	14.5	1000	1100	1290
LED InstantFit T8 U-Bent - 6" High Output							
45266-4	16.5	17.5	19	25.5	1800	2000	2700
45267-2	16.5	17.5	19	25.5	1800	2000	2700
45268-0	16.5	17.5	19	25.5	1900	2100	2800
45269-8	16.5	17.5	19	25.5	1950	2150	2900
LED InstantFit PL-L - 2' High Output							
45663-2	17	N/A	21	N/A	N/A	1900	N/A
45664-0	17	N/A	21	N/A	N/A	2000	N/A
45665-7	17	N/A	21	N/A	N/A	2100	N/A

1. Please refer to the InstantFit ballast compatibility guide @ www.philips.com/instantfit. Compatibility subject to change as additional ballasts are tested. If you do not see your ballast on the compatibility list please contact your local Philips Lighting representative.
2. Must follow guidelines for installation from Philips Quick Installation Guide included with lamp shipment.
3. (2) Lamp F32T8 Electronic Instant Start System with 0.88 Ballast Factor= 58 System Watts; (2) Philips LED T8 InstantFit =29 System Watts; 58 - 29 = 29 System Watts Saved; 29/58 = 50% Energy Saved
4. See warranty for terms and conditions at www.philips.com/warranties
5. Tested to B50 L70 requirement.
6. Photometric testing consistent with IES LM-79.

● This lamp is DLC qualified.

System Power Compatibility Guide

This chart shows the measured system wattage of the Philips InstantFit TLED versus a comparable linear fluorescent lamp when used with the reference ballast.

	Reference Ballast	ICN-1P32-N	ICN-2P32-N	ICN-3P32-N	ICN-4P32-N
	Ballast Factor	0.88	0.88	0.88	0.88
	Number of Lamps	1	2	3	4

	Lamp Type	System Power (W)*			
Specification	F32T8	31	59	85	112
	InstantFit 12 W	12.5	27.5	40	58
	InstantFit 15 W	24	35.5	46	63

* Variance <10%

Philips InstantFit LED T8 Lamps

Shipping Data (Subject to change without notice)

Product Number	SKU UPC (0-46677)	Outer Bar Code (5-00-46677)	Case Qty.	Case Weight (lbs.)	Case Cube (cu. Ft.)	Pallet Qty	Lamps/ SKU	SKUs per Layer	Layers High	SKU Dimensions (W x D x H) (In.)	Case Dimensions (W x D x H) (In.)	Pallet Dimensions (W x D x H) (In.)
LED InstantFit T8 - 4'												
45358-9	45358-9	45358-4	10	4.6	.59	600	1	60	10	1.1 x 1.1 x 48.0	48.8 x 6.0 x 3.5	49.2 x 39.4 x 40.9
45359-7	45359-6	45359-1	10	4.6	.59	600	1	60	10	1.1 x 1.1 x 48.0	48.8 x 6.0 x 3.5	49.2 x 39.4 x 40.9
45360-5	45360-2	45360-7	10	4.6	.59	600	1	60	10	1.1 x 1.1 x 48.0	48.8 x 6.0 x 3.5	49.2 x 39.4 x 40.9
45361-3	45361-9	45361-4	10	4.6	.59	600	1	60	10	1.1 x 1.1 x 48.0	48.8 x 6.0 x 3.5	49.2 x 39.4 x 40.9
LED InstantFit T8 - 4' Dimmable High Output												
45689-7	45689-4	45689-9	10	4.6	.43	600	1	60	10	1.1 x 1.1 x 48.0	48.8 x 6.0 x 3.5	49.2 x 39.4 x 40.9
45690-5	45690-0	45690-5	10	4.6	.43	600	1	60	10	1.1 x 1.1 x 48.0	48.8 x 6.0 x 3.5	49.2 x 39.4 x 40.9
45691-3	45691-7	45691-2	10	4.6	.43	600	1	60	10	1.1 x 1.1 x 48.0	48.8 x 6.0 x 3.5	49.2 x 39.4 x 40.9
45692-1	45692-4	45692-9	10	4.6	.43	600	1	60	10	1.1 x 1.1 x 48.0	48.8 x 6.0 x 3.5	49.2 x 39.4 x 40.9
LED InstantFit T8 - 4' Glass												
45656-6	45656-6	45656-1	10	4.6	.59	600	1	60	10	1.1 x 1.1 x 48.0	48.8 x 6.0 x 3.5	49.2 x 39.4 x 40.9
45657-4	45657-3	45657-8	10	4.6	.59	600	1	60	10	1.1 x 1.1 x 48.0	48.8 x 6.0 x 3.5	49.2 x 39.4 x 40.9
LED InstantFit T8 - 3'												
45205-2	45205-6	45205-1	10	4.63	.43	700	1	70	10	1.1 x 1.1 x 36.0	36.5 x 6.0 x 3.4	47.2 x 39.4 x 39.6
45206-0	45206-3	45206-8	10	4.63	.43	700	1	70	10	1.1 x 1.1 x 36.0	36.5 x 6.0 x 3.4	47.2 x 39.4 x 39.6
45207-8	45207-0	45207-5	10	4.63	.43	700	1	70	10	1.1 x 1.1 x 36.0	36.5 x 6.0 x 3.4	47.2 x 39.4 x 39.6
45208-6	45208-7	45208-2	10	4.63	.43	700	1	70	10	1.1 x 1.1 x 36.0	36.5 x 6.0 x 3.4	47.2 x 39.4 x 39.6
LED InstantFit T8 - 2' High Output												
45201-1	45201-8	45201-3	10	4.63	.43	700	1	70	10	1.1 x 1.1 x 36.0	36.5 x 6.0 x 3.4	47.2 x 39.4 x 39.6
45202-9	45202-5	45202-0	10	4.63	.43	700	1	70	10	1.1 x 1.1 x 36.0	36.5 x 6.0 x 3.4	47.2 x 39.4 x 39.6
45203-7	45203-2	45203-7	10	4.63	.43	700	1	70	10	1.1 x 1.1 x 36.0	36.5 x 6.0 x 3.4	47.2 x 39.4 x 39.6
45204-5	45204-9	45204-4	10	4.63	.43	700	1	70	10	1.1 x 1.1 x 36.0	36.5 x 6.0 x 3.4	47.2 x 39.4 x 39.6
LED InstantFit T8 U-Bent - 6" High Output												
45266-4	45266-7	45266-2	10	5.95	1.19	300	1	100	3	1.1 x 7.2 x 23.0	23.1 x 7.5 x 11.9	47.2 x 39.4 x 41.4
45267-2	45267-4	45267-9	10	5.95	1.19	300	1	100	3	1.1 x 7.2 x 23.0	23.1 x 7.5 x 11.9	47.2 x 39.4 x 41.4
45268-0	45268-1	45268-6	10	5.95	1.19	300	1	100	3	1.1 x 7.2 x 23.0	23.1 x 7.5 x 11.9	47.2 x 39.4 x 41.4
45269-8	45269-8	45269-3	10	5.95	1.19	300	1	100	3	1.1 x 7.2 x 23.0	23.1 x 7.5 x 11.9	47.2 x 39.4 x 41.4
LED InstantFit PL-L - 2' High Output												
45663-2	45663-4	45663-9	10	4.65	0.29	1200	1	150	8	23.3 x 0.5 x 4.3	23.3 x 5.0 x 4.3	47.3 x 39.4 x 40.2
45664-0	45664-1	45664-6	10	4.65	0.29	1200	1	150	8	23.3 x 0.5 x 4.3	23.3 x 5.0 x 4.3	47.3 x 39.4 x 40.2
45665-7	45665-8	45665-3	10	4.65	0.29	1200	1	150	8	23.3 x 0.5 x 4.3	23.3 x 5.0 x 4.3	47.3 x 39.4 x 40.2

PLt-1309BN 08/15 philips.com

Philips Lighting, North America Corporation
200 Franklin Square Drive, Somerset, NJ 08873
Tel. 855-486-2216

Imported by: Philips Lighting,
A division of Philips Electronics Ltd.
281 Hillmount Rd, Markham, ON, Canada L6C 2S3
Tel. 800-668-9008

PRECISION P2 PARAGON
EFFICIENCY. ECONOMY. SUSTAINABILITY.

TKG

LED Prismatic Troffer Retrofit Kit

Product Information

Project Name	Type
Catalog Number	Date

SPECIFICATIONS

Features

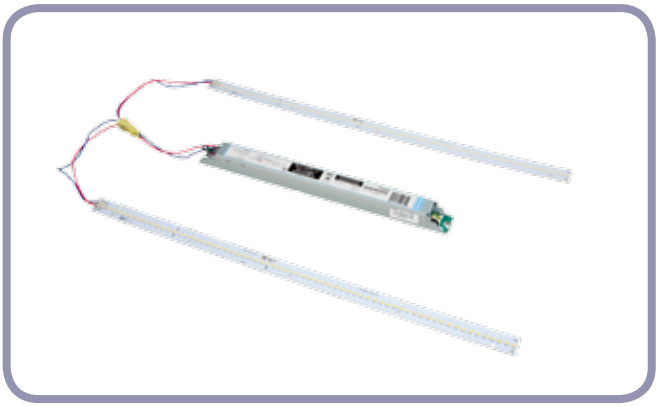
- Low cost LED prismatic troffer retrofit kit
- Long Life 60,000 hour LEDs at L80 for reduced maintenance
- Four LED color choices and 80 CRI
- Available in 2x2 and 2x4 configurations
- Lumen packages ranging from 1400–4800 lumens are consistent with typical delivered lumens provided by lensed troffers
- Efficacy over 100 LPW
- LED boards are provided with thermal adhesive for easy mounting and optimized heat dissipation
- High performance LED driver standard; 0-10V dimming driver optional.
- Pre-wired components for easy installation and maintenance
- Compatible with most lighting control systems
- Five year warranty

Construction

- Retrofit kit includes four LED boards utilizing adhesive tape attachment and LED driver.
- Alignment tool, sold separately, simplifies accurate placement of boards and decreases installation time.

Electrical

- Input Voltage Range: 120-277VAC 50/60Hz
- Driver options include fixed output for on/off function, or continuous 0-10V dimming
- Temperature rating of -40C to 35C



Certifications

- All kits are built to UL 1598 and 2108 standards.
- Luminaire bear appropriate labeling.
- Adheres to LM79, LM80 and TM21 industry standards.
- Maintains insulation contact (IC) rating of existing fixture.

Application

- Ideal for commercial offices, educational facilities, retail and health care facilities.

Warranty

- Five-year warranty. (Terms and Conditions Apply)

CERTIFICATION

c SP us

ORDERING INFORMATION

EXAMPLE **TKG24-40LW-EU**

MODEL	SIZE	–	COLOR TEMP	LUMEN OUTPUT	–	DRIVER	VOLTAGE
TKG LED Retrofit Kit	**22** 2x2 Nominal		**30** 3000K	**XW** Extra Low Wattage (2x4 Only)		**E** Fixed Output	**U** Universal 120–277 VAC
	24 2x4 Nominal		**35** 3500K	**VW** Very Low Wattage		**ED** 0-10V Dimming[1]	
			40 4000K	**MW** Medium Low Wattage			
			50 5000K	**LW** Low Wattage			
				ML Medium Lumen			
				HL High Lumen (2x2 Only)			
				VL Very High Lumen (2x2 Only)			

ACCESSORIES (ORDER SEPARATELY)

AT Alignment Tool[2] Part #93062081

FOOTNOTES

1. Must be used in conjunction with lighting controls.
2. Recommended for proper placement.

PHOTOMETRIC DATA

PHOTOMETRIC DATA: TKG22-35MW-ED

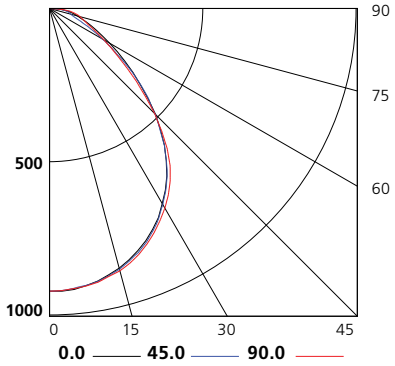
All published luminaire photometric testing performed to IESNA LM-79-08 standards by a NVLAP certified lab.

Test: 15611
Test Date: 09/16/15

LUMINAIRE DATA

Luminaire	**TKG22-35MW-ED**
Ballast	**D700CC55UNVTZ-C**
Ballast Factor	**1.00**
Lamp	**LED**
Fixture Lumens	**2039**
Watts	**20**
Mounting	**Recessed**
Shielding Angle	**N.A.**
Spacing Criterion	**0° = 1.19 90° = 1.21**
Luminous Opening in Feet	**Length: 1.83'** **Width: 1.83'** **Height: 0.00'**

INDOOR CANDELA PLOT



ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixt
0–30	703	35
0–40	1121	55
0–60	1752	86
0–90	2039	100
0–180	2039	100

PHOTOMETRIC DATA: TKG24-35ML-ED

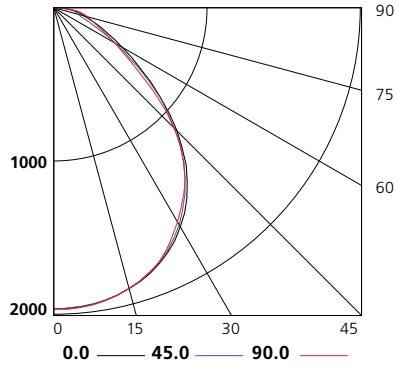
All published luminaire photometric testing performed to IESNA LM-79-08 standards by a NVLAP certified lab.

Test: 15613
Test Date: 09/14/15

LUMINAIRE DATA

Luminaire	**TKG24-35ML-ED**
Ballast	**D15CC55UNVTZ-C**
Ballast Factor	**1.00**
Lamp	**LED**
Fixture Lumens	**4567**
Watts	**42**
Mounting	**Recessed**
Shielding Angle	**N.A.**
Spacing Criterion	**0° = 1.24 90° = 1.22**
Luminous Opening in Feet	**Length: 3.75'** **Width: 1.75'** **Height: 0.00'**

INDOOR CANDELA PLOT



ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixt
0–30	1530	34
0–40	2462	54
0–60	3914	86
0–90	4567	100
0–180	4567	100

LUMEN PACKAGE OPTIONS

2X2 - CCT 3500K

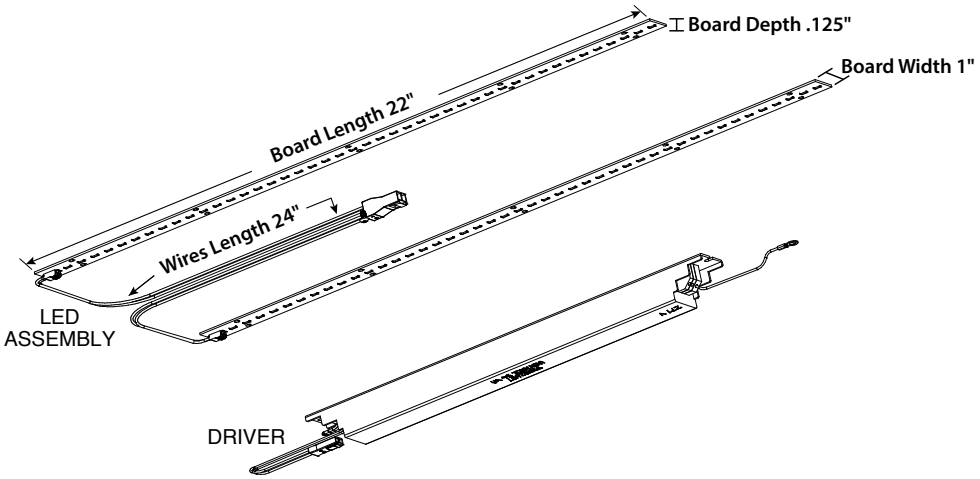
	CRI	Lumen Output	Input Watts	Lumens Per Watt
VW	>80	1400–1600	15	93–106
MW	>80	2000–2300	20	100–115
LW	>80	2300–2500	24	95–104
ML	>80	3100–3400	33	93–103
HL	>80	3300–3600	35	94–102
VL	>80	4200–4500	48	88–94

2X4 - CCT 3500K

	CRI	Lumen Output	Input Watts	Lumens Per Watt
XW	>80	2300–2600	22	104–118
VW	>80	2900–3200	27	107–118
MW	>80	3400–3800	33	103–115
LW	>80	4000–4400	37	108–118
ML	>80	4400–4800	43	102–111

Lumen values shown are initial delivered lumens tested at 25°C per IES LM-79 standards.

DIMENSIONS



FIT AND FUNCTION

Precision-Paragon[P2] recommends a trial installation prior to ordering project quantities to ensure proper fit. TKG is designed to fit into most standard lensed-recessed troffers.

PRECISION P2 PARAGON
EFFICIENCY. ECONOMY. SUSTAINABILITY.

TKL

LED Prismatic Troffer Conversion Kit

Product Information

Project Name	Type
Catalog Number	Date

SPECIFICATIONS

Features

- Retrofits fluorescent prismatic troffers with state-of-the-art Solid State Lighting technology.
- Output up to 6,400 lumens.
- Up to 127 lumens per watt.
- Rapid installation.
- Long-life, 60,000 hour LEDs at L80 (80% lumen maintenance) reduces life cycle maintenance costs.
- Choice of four lumen packages and dimming option available.
- Low W/ft^2 to meet the most restrictive lighting power density codes.
- Reduces job site waste by reusing existing fixture housing & prismatic lens.
- Color Rendering Index (CRI) > 80.
- Available in both 2x2 and 2x4 configurations.
- Made In USA. Meets ARRA & Buy American requirements.

Construction

- Conversion kit includes pre-wired reflector LED assembly.
- White aluminum reflector, 90-91% reflectivity.
- Weight: 2x2 - 2 lbs. & 2x4 - 3 lbs.
- (2) Mounting brackets.
- (4) Tek screws.

Electrical

- Input Voltage Range: 100-277 VAC Nom. (90-305 V Min/Max)
- Frequency: 50/60 Hz Nom. (47-63 Hz Min/Max)
- Active Power Factor Correction
- Power Factor: >0.90 @ full load, 100V through 277V
- Inrush Current: 42 Amps max @ 220 VAC, cold start 25ºC
- Harmonic Distortion: THD < 20% @ full load
- Protection: Over-Voltage, Over-Temperature (110º) & Short Circuit with self-recovery
- Compliant to FCC Part 15 requirements for EMI/RFI emissions
- NEC/CEC compliant ballast disconnect is standard
- Standard surge protection: ANSI Std. C62.41-2002 Category A (2.5 kV)
- Optional surge protection: ANSI Std. C62.41-2002 Category C High (10kA and 10kV)
- Optional emergency battery pack

Certifications

- UL listed 1598, 1598C and cUL for Canada.
- Luminaires bear appropriate listing labels.
- Emergency-equipped fixtures labeled UL 924.
- Adheres to LM79, LM80 and TM21 industry standards.
- Maintains insulation contact (IC) rating of existing fixture.
- DesignLights Consortium® (DLC) qualified.
- Please refer to the DLC website for specific product qualifications at www.designlights.org.
- Please refer to the Lighting Facts website for specific product qualifications at www.lightingfacts.com.

Application

- Ideal for Commercial Offices, Educational Facilities, Retail, and Health Care Facilities.
- Suitable for use with most wired or wireless lighting control systems.
- Suitable for Dry or Damp Locations.

Warranty

- Five-year warranty. (Terms and Conditions Apply)

CERTIFICATION

c UL us · DLC LISTED · RoHS · DAMP LOCATION · TITLE 24 COMPLIANT

ORDERING INFORMATION

EXAMPLE **TKL-2X4-LW-F-UL-35K**

–		–		–		–		–		–	
MODEL		**SIZE**		**LUMEN OUTPUT**		**DRIVER OUTPUT**		**DRIVER VOLTAGE**		**COLOR TEMP**		**OTHER**	
TKL	LED Prismatic Troffer Conversion Kit	**2x2**	2x2 Nominal	**XL**	Extra Low	**F**	Fixed	**UL**	Universal 120-277 Volt	**35K**	3500	**LSP**	Lighting Surge Protector
		2x4	2x4 Nominal	**LW**	Low	**DM**	0-10v Dimming[1]			**40K**	4000	**EB**	Emergency Battery Backup[2]
				ML	Medium					**50K**	5000 (Non DLC)	**JP**	Job Pack
				HL	High (2x2 Only)								

FOOTNOTES

[1]Must be used in conjunction with lighting controls. Contact factory for assistance.
[2]Emergency Battery Backup: 8 Watt (2x2); 16 Watt (2x4). Lumen value with emergency driver + battery pack: 2x2 = 692 lumens, 2x4 = 1200 lumens.

PHOTOMETRIC DATA

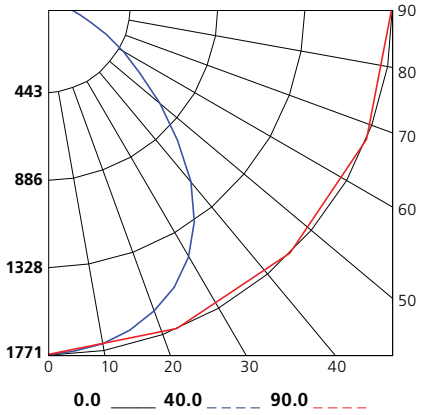
PHOTOMETRIC DATA: TKL-2X4-LW-DM-UL-35K
All published luminaire photometric testing performed to IESNA LM-79-08 standards by a NVLAP certified lab.

Test: L091407902
Test Date: 09/25/14

LUMINAIRE DATA

Luminaire	**TKL-2X4-LW-DM-UL-35K, LED Prismatic Troffer Conversion Kit**
Ballast	**LED40W-036-C1100-D**
Ballast Factor	**1.00**
Lamp	**LED**
Fixture Lumens	**4023**
Watts	**35**
Mounting	**Recessed**
Shielding Angle	**N/A**
Spacing Criterion	**0° = 1.24 90° = 1.20**
Luminous Opening in feet	**Length: 3.82** **Width: 1.81** **Height: 0.00**

INDOOR CANDELA PLOT



ZONAL LUMEN SUMMARY

Zone	Lumens	%Lamp	%Fixt
0-20	647	N.A.	16
0-30	1364	N.A.	34
0-40	2180	N.A.	54
0-60	3427	N.A.	85
0-80	3939	N.A.	98
0-90	4023	N.A.	100

COEFFICIENTS OF UTILIZATION (%)

RCR	RC	80				70				50			0
	RW	70	50	30	10	70	50	30	10	50	30	10	0
	0	119	119	119	119	116	116	116	116	111	111	111	100
	1	110	105	101	98	107	103	99	96	99	96	93	86
	2	101	93	87	82	98	91	86	81	88	83	79	73
	3	93	83	75	69	90	81	74	69	79	73	68	63
	4	86	74	66	60	83	73	65	60	71	64	59	55
	5	79	67	59	53	77	66	58	52	64	57	52	49
	6	73	61	53	46	72	60	52	46	58	51	46	43
	7	68	56	47	42	67	55	47	41	53	46	41	39
	8	64	51	43	37	62	50	43	37	49	42	37	35
	9	60	47	39	34	58	46	39	34	45	38	34	32
	10	56	44	36	31	55	43	36	31	42	35	31	29

RCR = Room Cavity Ratio **RC** = Effective Ceiling Cavity Reflectance **RW** = Wall Reflectance

AVG. LUMINANCE (Candela/Sq. M.)

Average Luminance Angle	0.0	22.5	45.0	67.5	90.0
0	1771	1771	1771	1771	1771
5	1757	1762	1763	1765	1764
10	1736	1740	1741	1741	1739
15	1700	1704	1702	1699	1695
20	1647	1649	1644	1635	1629
25	1573	1573	1562	1546	1540
30	1470	1467	1452	1434	1429
35	1335	1328	1313	1295	1293
40	1166	1157	1142	1127	1127
45	966	966	959	936	931
50	771	774	773	725	712
55	601	584	570	528	527
60	471	435	412	404	416
65	353	311	275	312	325
70	261	233	187	252	262
75	197	179	152	203	220
80	148	126	127	152	174
85	80	73	75	97	100

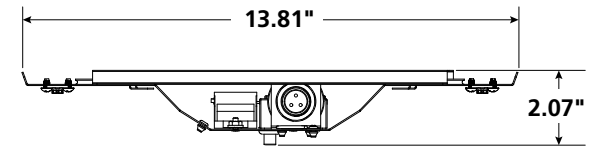
LUMEN PACKAGE OPTIONS

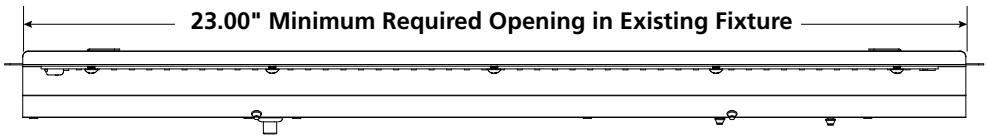
Proposed System	Light Source Quantity & Type		CRI	3500K DETAILS CCT	3500K DETAILS Lumens Per Fixture	3500K DETAILS Input Watts	3500K DETAILS Lumens Per Watt	4000K DETAILS CCT	4000K DETAILS Lumens Per Fixture	4000K DETAILS Input Watts	4000K DETAILS Lumens Per Watt
TKL-2X2-XL	1	TKL XL Engine	>80	3500K	2200	23	97	4000K	2356	23	104
TKL-2X2-LW	1	TKL LWEngine	>80	3500K	2803	30	94	4000K	3048	30	102
TKL-2X2-ML	1	TKL ML Engine	>80	3500K	3186	35	91	4000K	3355	35	95
TKL-2X2-HL	1	TKL HL Engine	>80	3500K	4695	52	91	4000K	4832	52	93
TKL-2X4-XL	1	TKL XL Engine	>80	3500K	2854	25	114	4000K	3212	25	127
TKL-2X4-LW	1	TKL LWEngine	>80	3500K	4023	35	116	4000K	4445	37	121
TKL-2X4-ML	1	TKL ML Engine	>80	3500K	5138	48	108	4000K	5537	48	115

*Lumen values shown are initial delivered lumens tested at 25°C per IES LM-79 standards.

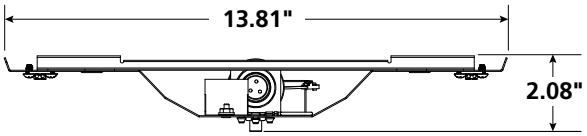
MINIMUM DIMENSIONS OF EXISTING FIXTURE OPENING

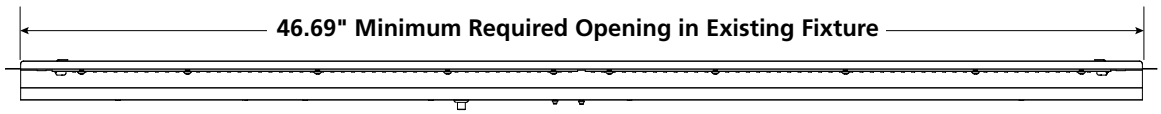
2X2 TKL CROSS SECTION & SIDE VIEW





2X4 TKL CROSS SECTION & SIDE VIEW





*Drawings N.T.S.

FIT AND FUNCTION

Minimum dimensional requirements are above but Precision-Paragon[P2] recommends a trial installation prior to ordering project quantities. TKL Coversion Kits are designed to fit into most lensed-recessed prismatic troffers mounted in T-grid installation.

RWLED3T78RG

LED roadway lighting that's easy to buy. Free trial program and leasing options make it easy to get started with LED. Specification-grade optics deliver efficient, clean, uniform light distributions at a reasonable cost. Optics are factory installed and meet IES Lateral Distribution Type III. LROAD™ 78W replaces 250W metal halide roadway fixtures.

Color: Gray

Weight: 32.0 lbs

Project:	Type:
Prepared By:	Date:

Driver Info

Type:	Constant Current
120V:	0.66A
208V:	0.41A
240V:	0.35A
277V:	0.30A
Input Watts:	78W
Efficiency:	99%

LED Info

Watts:	78W
Color Temp:	5100K (Cool)
Color Accuracy:	67 CRI
L70 Lifespan:	100,000
Lumens:	6,911
Efficacy:	88 LPW

Technical Specifications

Listings

UL Listing:

Suitable for wet locations as a downlight.

IESNA LM-79 & IESNA LM-80 Testing:

RAB LED fixtures have been tested by an independent laboratory in accordance with IESNA LM-79 and 80, and have received the Department of Energy "Lighting Facts" label.

DLC Listed:

This product is on the Design Lights Consortium (DLC) Qualified Products List and is eligible for rebates from DLC Member Utilities.

Dark Sky Approved:

The International Dark Sky Association has approved this product as a full cutoff, fully shielded luminaire.

Optical

Lumen Maintenance:

100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations.

Replacement:

The LROAD™ replaces 175W Mercury Vapor, 150W HPS/MH roadway fixtures.

BUG Rating:

B1 U0 G2

Construction

IES Classification:

The Type III distribution is ideal for roadway, general parking and other area lighting applications where a larger pool of lighting is required. It has greater streetside (transverse) throw, allowing the light to project outward and fill the area.

IP Rating:

Ingress Protection rating of IP66 for dust and water.

Vibration Rating:

Industry-leading 5G vibration rating per ANSI C136.31.

Ambient Temperature:

Suitable for use in 40°C ambient temperatures.

Cold Weather Starting:

The minimum starting temperature is -40°F/-40°C.

Thermal Management:

Superior patent pending thermal management design with external Air-Flow fins provides maximum operational life, even in high ambient temperature environments.

Effective Projected Area:

EPA = 0.75

Housing:

Die cast aluminum housing, lens frame and mounting arm.

Mounting:

Fits most standard roadway upsweep arms. Adaptor brackets supplied fit 1", 1 1/4", 1 1/2" and 2" OD arms.

Wedge Mounting Option:

Allows field adjustment of +/- 5 degree tilt to achieve a level installation of LROAD78 universal adaptor roadway fixtures.

Recommended Mounting Height:

Up to 25 ft.

Reflector:

Specular vacuum-metallized polycarbonate

Gaskets:

High temperature silicone gaskets

Finish:

Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color, and contains no VOC or toxic heavy metals.

Green Technology:

Mercury and UV free, and RoHS compliant. Polyester powder coat finish formulated without the use of VOC or toxic heavy metals.

LED Characteristics

LEDs:

Six (6) multi-chip, 13W, high-output, long-life LEDs.

Color Consistency:

7-step MacAdam Ellipse binning to achieve consistent fixture-to-fixture color.

Color Stability:

LED color temperature is warrantied to shift no more than 200K in CCT over a 5 year period.

Color Uniformity:

RAB's range of CCT (Correlated Color Temperature) follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2011.

Technical Specifications (continued)

Electrical

Driver:

Constant Current, Class 2, 2000mA, 100-277V, 50-60Hz, 1.1A, Power Factor 99%

THD:

5.3% at 120V, 13.3% at 277V

Surge Protection:

6kV surge suppression protection tested in accordance with IEEE/ANSI C62.41.2.

Other

Equivalency:

LROAD™ 78W replaces 250W metal halide

California Title 24:

See RWLED2T78/D10, RWLED2T78/BL, RWLED2T78/PCS, RWLED2T78/PCS2, or RWLED2T78/PCT for a 2013 California Title 24 compliant product. Any additional component requirements will be listed in the Title 24 section under technical specifications on the product page.

Patents:

The LROAD™ design is protected by patents pending in the U.S., Canada, China, Taiwan and Mexico.

Warranty:

RAB warrants that our LED products will be free from defects in materials and workmanship for a period of ten (10) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish.

Country of Origin:

Designed by RAB in New Jersey and assembled in the USA by RAB's IBEW Local 3 workers.

Buy American Act Compliant:

This product is a COTS item manufactured in the United States, and is compliant with the Buy American Act.

Recovery Act (ARRA) Compliant:

This product complies with the 52.225-21 "Required Use of American Iron, Steel, and Manufactured Goods-- Buy American Act-- Construction Materials (October 2010).

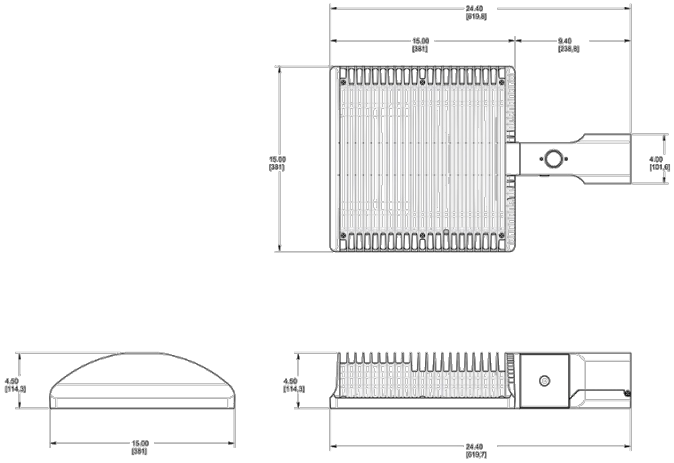
Trade Agreements Act Compliant:

This product is a COTS item manufactured in the United States, and is compliant with the Trade Agreements Act.

GSA Schedule:

Suitable in accordance with FAR Subpart 25.4.

Dimensions



Features

- Ideal for roadway, general parking and major roads
- 78W High-Performance LED
- Replaces 250W metal halide roadway fixtures
- 27 year lifespan dramatically reduces maintenance and re-lamping costs
- Precision optics deliver maximum downward street side lumens with uniformity and minimal glare
- Compatible with standard roadway arms
- Universal adaptors for 1", 1 1/4", 1 1/2" and 2" OD pipe included
- Industry-leading 5G vibration rating per ANSI C136.31
- Easy-access electrical compartment makes wiring fast and secure
- 10-Year no compromise warranty

Ordering Matrix

Family	Distribution	Watts	Color Temp	Finish	Dimming	Voltage	Photocell	Bi-Level
RWLED								
	3T = Type III	**78** = 78W	= Cool **Y** = Warm **N** = Neutral	= Bronze **W** = White **RG** = Gray	= No Dimming **/D10** = Dimmable	= 120-277V **/480** = 480V	= No Photocell **/PCT** = 120-277V Twistlock **/PCT4** = 480V Twistlock	= No Bi-Level **/BL** = Bi-Level

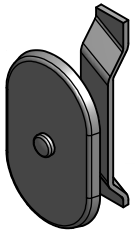
NO.	POLE SHAFT SPECIFICATIONS
1.	SHAFTS ARE ONE SECTION DESIGN FABRICATED FROM A WELDABLE GRADE CARBON STEEL STRUCTURAL TUBING WITH A UNIFORM WALL THICKNESS. MATERIAL SHALL CONFORM TO ASTM A-500 GRADE B WITH A MINIMUM YIELD STRENGTH OF 46,000 P.S.I.
2.	BASE PLATES ARE CONSTRUCTED OF A STRUCTURAL QUALITY HOT ROLLED CARBON STEEL PLATE (ASTM A-36 HRS) WITH A GUARANTEED MINIMUM YIELD STRENGTH OF 36,000 P.S.I.
3.	POLES SHALL HAVE A POLYESTER POWDER COAT DARK BRONZE FINISH.

POLE DIMENSIONS				
POLE HGT (FT.)	TOP SQ. SIZE (IN.)	BOT. SQ. SIZE (IN.)	GAGE	MTG. HGT. (FT.)
25'	4.00	4.00	11 GAGE	25'

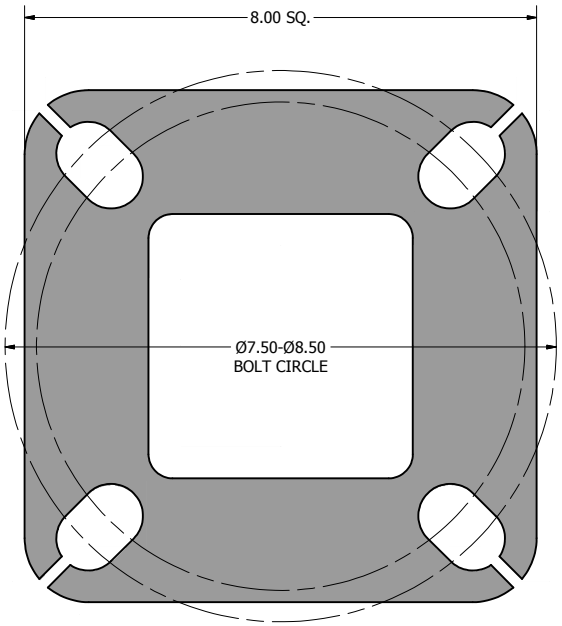
BASE PLATE DIMENSIONS			
BOLT CIRCLE (IN.)	BASE PLATE DIM. (IN.)	BOLT HOLE (IN.)	PLATE THK. (IN.)
7.50-8.50	8.00 SQ.	1.00	.75

ALLOWABLE WIND LOADING (SQ. FT.)				
WIND*	80 MPH	90 MPH	100 MPH	120 MPH
EPA	4.1	3.3	2.6	1.8

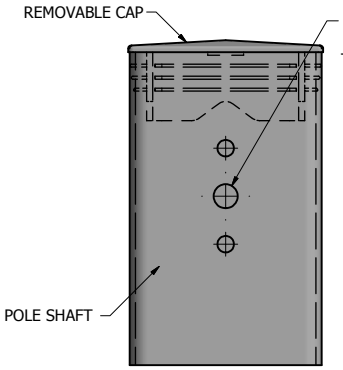
*WITH 1.3 GUST FACTOR



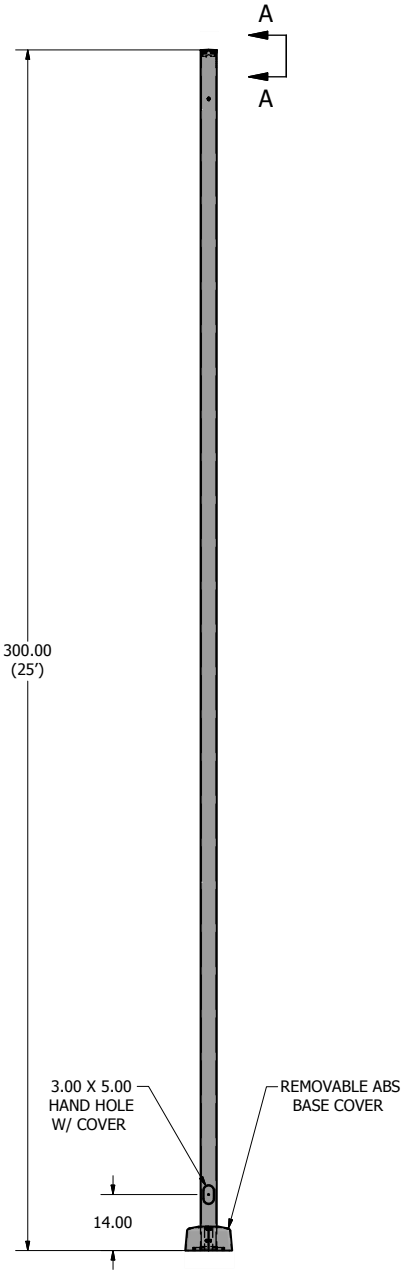
3.00 X 5.00 HAND HOLE COVER



8.00 X 8.00 X .75 THK. BASE PLATE



VIEW A-A
DRILL TEMPLATE TBD
D1 AT 90°



POLE DETAIL

lyte poles
a DWM company
P.O. Box 340
Eastpointe, MI 48021
P: (586) 771-4610 | F: (586) 771-5527
www.lytepoles.com

DRAWN: L. GRUNIS	11/19/2015	
CHECKED		
REVISION:	DATE:	
APPROVED:		
QUOTE: 1504686		
S.O.#		
REF:	SCALE: NONE	

SOME GEOGRAPHICAL AREAS HAVE SPECIAL WIND CONDITIONS THAT CAN CREATE WIND INDUCED VIBRATIONS CAUSING A FATIGUE PROBLEM. NO METHOD HAS YET BEEN FOUND FOR PREDICTING DESTRUCTIVE LIGHTING POLE VIBRATION. THESE CONDITIONS ARE UNIQUE AND CANNOT BE GUARANTEED AGAINST, AND ARE THE RESPONSIBILITY OF A LOCAL SITE ENGINEER.

TITLE:	SMARTWATT		
CATALOG:	101-4011-25-MODBASE-D1-DB-L/ABT		
DWG NO:	SD-9106	SIZE C	SHEET 1 OF 1

180°
270° 90°
0°
HANDHOLE

C - 32

SLIM26/PC

12, 18 and 26 Watt SLIM wallpacks are ultra efficient and deliver impressive light distribution with a compact low-profile design that's super easy to install as a downlight or uplight.

Color: Bronze Weight: 4.5 lbs

Project:	Type:
Prepared By:	Date:

Driver Info		LED Info	
Type:	Constant Current	Watts:	26W
120V:	0.27A	Color Temp:	5100K (Cool)
208V:	N/A	Color Accuracy:	67 CRI
240V:	N/A	L70 Lifespan:	100,000
277V:	N/A	Lumens:	2,849
Input Watts:	29W	Efficacy:	97 LPW
Efficiency:	88%		

Technical Specifications

Other

SLIM26 with Photocell:

120V Button Photocell Included. Photocell is only compatible with 120V.

HID Replacement Range:

The SLIM26 can be used to replace 175W MH based on delivered lumens.

California Title 24:

See SLIM26/D10 for a 2013 California Title 24 compliant product. Any additional component requirements will be listed in the Title 24 section under technical specifications on the product page.

Patents:

The design of the SLIM™ is protected by patents in U.S. Pat D681,864, and pending patents in Canada, China, Taiwan and Mexico.

Listings

UL Listing:

Suitable for wet locations. Suitable for mounting within 1.2m (4ft) of the ground.

ADA Compliant:

SLIM™ is ADA Compliant.

DLC Listed:

This product is on the Design Lights Consortium (DLC) Qualified Products List and is eligible for rebates from DLC Member Utilities.

Dark Sky Approved:

The International Dark Sky Association has approved this product as a full cutoff, fully shielded luminaire.

IESNA LM-79 & LM-80 Testing:

RAB LED luminaires have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80, and have received the Department of Energy "Lighting Facts" label.

Construction

IP Rating:

Ingress Protection rating of IP66 for dust and water.

Ambient Temperature:

Suitable for use in 40°C (104°F) ambient temperatures.

Thermal Management:

Superior heat sinking with internal Air-Flow fins.

Housing:

Precision die-cast aluminum housing.

Mounting:

Heavy-duty mounting bracket with hinged housing for easy installation.

Recommended Mounting Height:

Up to 22 ft.

Lens:

Tempered glass lens.

Reflector:

Specular thermoplastic.

Gaskets:

High-temperature silicone.

Finish:

Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color, and contains no VOC or toxic heavy metals.

Green Technology:

Mercury and UV free, and RoHS compliant.

LED Characteristics

LED:

Multi-chip, long-life LED.

Lifespan:

100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations.

Color Consistency:

7-step MacAdam Ellipse binning to achieve consistent fixture-to-fixture color.

Color Stability:

LED color temperature is warrantied to shift no more than 200K in CCT over a 5 year period.

Color Uniformity:

RAB's range of CCT (Correlated Color Temperature) follows the guidelines for the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2011.

Electrical

Driver:

Constant Current, Class 2, 100-277V, 50/60 Hz., 6KV surge protection, 720mA, 100-277VAC 0.4 Amps, Power Factor 99%.

Technical Specifications (continued)

Electrical

THD:

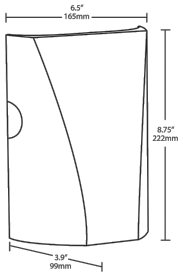
13% at 120V

Optical

BUG Rating:

B1 U0 G0

Dimensions



Features

- Full cutoff, fully shielded LED wallpack
- Can be used as a downlight or uplight
- Contractor friendly features for easy installation
- 100,000-hour LED Life
- 5-Year Warranty

Ordering Matrix

Family	Watts	Color Temp	Finish	Photocell	Dimming
SLIM					
	26 = 26W **18** = 18W **12** = 12W	= Cool **Y** = Warm **N** = Neutral	= Bronze **W** = White	= No Photocell **/PC** = 120V Button **/PC2** = 277V Button	= No Dimming **/D10** = Dimmable

SLIM37

37, 57 and 62 Watt SLIM Wallpacks are designed to cover the footprint of most traditional wallpacks. They are suitable for mounting heights from 20' to 30', and replace HID Wattages from 200W MH to 320W MH. These ultra-high efficiency fixtures are available in cutoff or full cutoff models.

Color: Bronze

Weight: 7.5 lbs

Project:	Type:
Prepared By:	Date:

Driver Info		LED Info	
Type:	Constant Current	Watts:	37W
120V:	0.31A	Color Temp:	5000K (Cool)
208V:	0.19A	Color Accuracy:	75 CRI
240V:	0.16A	L70 Lifespan:	100,000
277V:	0.14A	Lumens:	2,688
Input Watts:	37W	Efficacy:	73 LPW
Efficiency:	N/A		

Technical Specifications

Listings

UL Listing:

Suitable for wet locations. Wall Mount only.

DLC Listed:

This product is on the Design Lights Consortium (DLC) Qualified Products List and is eligible for rebates from DLC Member Utilities.

IESNA LM-79 & LM-80 Testing:

RAB LED luminaires have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80, and have received the Department of Energy "Lighting Facts" label.

Construction

Footprint:

Designed to replace RAB HID WP1 wallpacks, both in size and footprint template, so upgrading to LED is easy and seamless.

IP Rating:

Ingress Protection rating of IP66 for dust and water.

Cold Weather Starting:

The minimum starting temperature is -40°F/-40°C.

Ambient Temperature:

Suitable for use in 40°C (104°F) ambient temperatures.

Thermal Management:

Superior thermal management with internal Air-Flow fins.

Housing:

Precision die-cast aluminum housing and door frame.

Mounting:

Die-cast back box with four (4) conduit entry points and knockout pattern for junction box or direct wall mounting. Hinged housing and bubble level for easy installation.

Cutoff:

Cutoff (7.5°)

Recommended Mounting Height:

Up to 20 ft.

Lens:

Microprismatic diffusion glass lens reduces glare and has smooth and even light distribution.

Reflector:

Specular thermoplastic.

Gaskets:

The unique design of the tight-lock gasket ensures no water or environmental elements will ever get inside the SLIM.

Finish:

Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color, and contains no VOC or toxic heavy metals.

Green Technology:

Mercury and UV free, and RoHS compliant.

LED Characteristics

LED:

Long-life, high-efficiency, micro-power, surface mount LEDs; binned and mixed for uniform light output and color.

Lifespan:

100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations.

Correlated Color Temp. (Nominal CCT):

5000K

Color Stability:

LED color temperature is warrantied to shift no more than 200K in CCT over a 5 year period.

Color Consistency:

7-step MacAdam Ellipse binning to achieve consistent fixture-to-fixture color.

Electrical

Driver:

Constant Current, 100-277V. 50/60Hz, 100-277VAC 0.6A, 4kV Surge Protection, 700mA, Power Factor 99.6%.

THD:

7.3% at 120V, 8.5% at 277V

Other

HID Replacement Range:

The SLIM37 can be used to replace 200W MH based on delivered lumens.

Accessories:

Available accessories include polyshield and wire guard. Click to see all accessories.

Technical Specifications (continued)

Other

California Title 24:

See SLIM37/BL for a 2013 California Title 24 compliant product. Any additional component requirements will be listed in the Title 24 section under technical specifications on the product page.

Patents:

The design of the SLIM™ is protected by patents pending in US, Canada, China, Taiwan and Mexico.

Warranty:

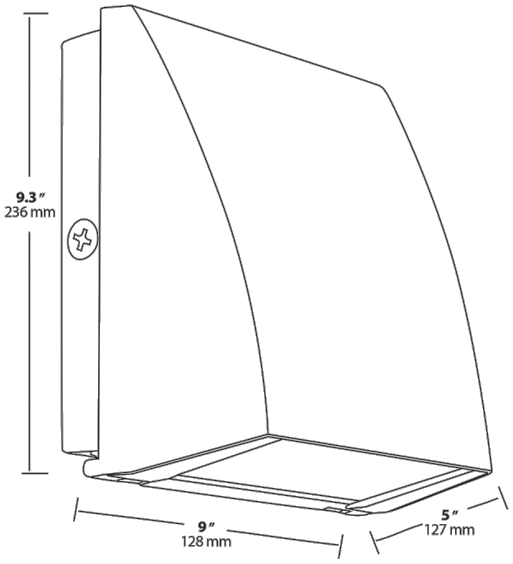
RAB warrants that our LED products will be free from defects in materials and workmanship for a period of five (5) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish.

Optical

BUG Rating:

B1 U1 G1

Dimensions



Features

Covers footprint of most traditional wallpacks

Easy installation with hinged access, bubble level and multiple conduit entries

Tight-lock gasket keeps elements out

100,000-hour LED lifespan

5-Year warranty

Ordering Matrix

Family	Cutoff	Watts	Color Temp	Finish	Photocell	Bi-Level
SLIM						
	= Standard **C** = Cutoff **FC** = Full Cutoff	**62** = 62W **57** = 57W **37** = 37W	= Cool **Y** = Warm **N** = Neutral	= Bronze **W** = White	= No Photocell **/PC** = 120V Button **/PC2** = 277V Button **/PCS** = 120V Swivel **/PCS2** = 277V Swivel	= No Bi-Level **/BL** = Bi-Level

VANLED20W

Low-profile vandal-resistant fixture covers the footprint of most traditional canopy lights. Available in flat or drop lens.

Color: White

Weight: 12.0 lbs

Project:	Type:
Prepared By:	Date:

Driver Info		LED Info	
Type:	Constant Current	Watts:	20W
120V:	0.30A	Color Temp:	5000K (Cool)
208V:	0.20A	Color Accuracy:	74 CRI
240V:	0.17A	L70 Lifespan:	100,000
277V:	0.15A	Lumens:	2,352
Input Watts:	22W	Efficacy:	108 LPW
Efficiency:	92%		

Technical Specifications

Listings

UL Listing:

Suitable for wet locations.

IESNA LM-79 & LM-80 Testing:

RAB LED luminaires have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80, and have received the Department of Energy "Lighting Facts" label.

DLC Listed:

This product is on the Design Lights Consortium (DLC) Qualified Products List and is eligible for rebates from DLC Member Utilities.

Electrical

Driver:

Class 2, Constant Current, 100-277V, 50-60Hz, 500mA

THD:

6.1% at 120V, 10.1% at 277V

Construction

Ambient Temperature:

Suitable for use in 40°C (104°F) ambient temperatures.

Cold Weather Starting:

Minimum starting temperature is -40°F/-40°C

Housing:

Die-cast aluminum housing and lens frame with (4) 1/2" NPS side conduit entries and weatherproof rear wire plug and access plate

Mounting:

Ceiling mount to recessed junction with knockout template or directy to ceiling surface, utilizing side conduit entry points.

IP Rating:

Ingress Protection rating of IP66 for dust and water.

Lens:

Vandal-resistant polycarbonate textured opaque for low glare drop lens

Reflector:

Semi-specular, vacuum-metalized polycarbonate

Gaskets:

High-temperature silicone gaskets

Finish:

Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color, and contain no VOC or toxic heavy metals.

Green Technology:

Mercury and UV free, and RoHS compliant. Polyester powder coat finish formulated without the use of VOC or toxic heavy metals.

LED Characteristics

LEDs:

Discreet LEDs on PCB board

Color Stability:

RAB LEDs exceed industry standards for chromatic stability.

Color Uniformity:

RAB's range of CCT (Correlated Color Temperature) follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2011.

Other

Country of Origin:

Designed by RAB in New Jersey and assembled in the USA by RAB's IBEW Local 3 workers.

Buy American Act Compliant:

This product is a COTS item manufactured in the United States, and is compliant with the Buy American Act.

Recovery Act (ARRA) Compliant:

This product complies with the 52.225-21 "Required Use of American Iron, Steel, and Manufactured Goods-- Buy American Act-- Construction Materials (October 2010).

Trade Agreements Act Compliant:

This product is a COTS item manufactured in the United States, and is compliant with the Trade Agreements Act.

GSA Schedule:

Suitable in accordance with FAR Subpart 25.4.

California Title 24:

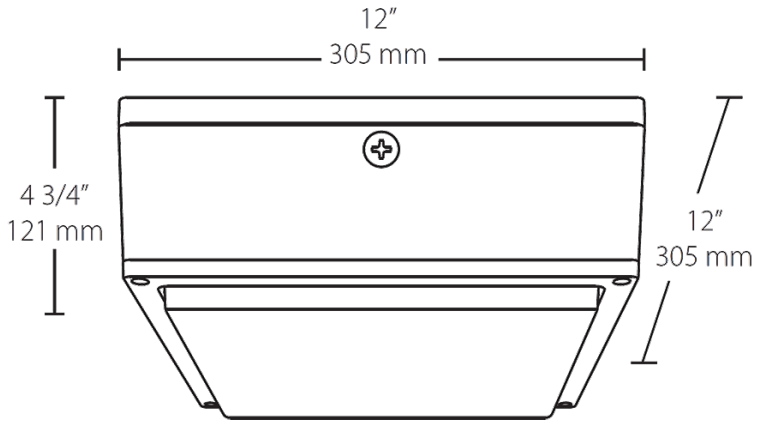
See VANLED20/PCS, VANLED20/PCS2 or VANLED20MS for a 2013 California Title 24 compliant model.

Replacement:

The VANLED 20W replaces up to 70W Metal Halide.

VANLED20W

Dimensions



Features

- Fits the footprint of older canopy lights
- Vandal resistant and UV resistant lens
- Ultra-high efficiency
- Clean, contemporary, low-profile design
- Available with drop lens or flat lens
- IP66 rated, keeps dust, bugs and water out
- Photo and motion sensor options available

Ordering Matrix

Family	Watts	Color Temp	Lens	Finish	Voltage	Dimming
VANLED						
	10 = 10W **20** = 20W **40** = 40W **52** = 52W **65** = 65W **75** = 75W	= Cool **Y** = Warm **N** = Neutral	= Drop lens **F** = Flat lens	= Bronze **W** = White	= 120-277V **/480** = 480V (10W & 20W not available)	= No Dimming **/D10** = Dimmable (10W & 20W not available)

VANLED20W

Low-profile vandal-resistant fixture covers the footprint of most traditional canopy lights. Available in flat or drop lens.

Color: White

Weight: 12.0 lbs

Project:	Type:
Prepared By:	Date:

Driver Info		LED Info	
Type:	Constant Current	Watts:	20W
120V:	0.30A	Color Temp:	5000K (Cool)
208V:	0.20A	Color Accuracy:	74 CRI
240V:	0.17A	L70 Lifespan:	100,000
277V:	0.15A	Lumens:	2,352
Input Watts:	22W	Efficacy:	108 LPW
Efficiency:	92%		

Technical Specifications

Listings

UL Listing:

Suitable for wet locations.

IESNA LM-79 & LM-80 Testing:

RAB LED luminaires have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80, and have received the Department of Energy "Lighting Facts" label.

DLC Listed:

This product is on the Design Lights Consortium (DLC) Qualified Products List and is eligible for rebates from DLC Member Utilities.

Electrical

Driver:

Class 2, Constant Current, 100-277V, 50-60Hz, 500mA

THD:

6.1% at 120V, 10.1% at 277V

Construction

Ambient Temperature:

Suitable for use in 40°C (104°F) ambient temperatures.

Cold Weather Starting:

Minimum starting temperature is -40°F/-40°C

Housing:

Die-cast aluminum housing and lens frame with (4) 1/2" NPS side conduit entries and weatherproof rear wire plug and access plate

Mounting:

Ceiling mount to recessed junction with knockout template or directy to ceiling surface, utilizing side conduit entry points.

IP Rating:

Ingress Protection rating of IP66 for dust and water.

Lens:

Vandal-resistant polycarbonate textured opaque for low glare drop lens

Reflector:

Semi-specular, vacuum-metalized polycarbonate

Gaskets:

High-temperature silicone gaskets

Finish:

Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color, and contain no VOC or toxic heavy metals.

Green Technology:

Mercury and UV free, and RoHS compliant. Polyester powder coat finish formulated without the use of VOC or toxic heavy metals.

LED Characteristics

LEDs:

Discreet LEDs on PCB board

Color Stability:

RAB LEDs exceed industry standards for chromatic stability.

Color Uniformity:

RAB's range of CCT (Correlated Color Temperature) follows the guidelines of the American National Standard for Specifications for the Chromaticity of Solid State Lighting (SSL) Products, ANSI C78.377-2011.

Other

Country of Origin:

Designed by RAB in New Jersey and assembled in the USA by RAB's IBEW Local 3 workers.

Buy American Act Compliant:

This product is a COTS item manufactured in the United States, and is compliant with the Buy American Act.

Recovery Act (ARRA) Compliant:

This product complies with the 52.225-21 "Required Use of American Iron, Steel, and Manufactured Goods-- Buy American Act-- Construction Materials (October 2010).

Trade Agreements Act Compliant:

This product is a COTS item manufactured in the United States, and is compliant with the Trade Agreements Act.

GSA Schedule:

Suitable in accordance with FAR Subpart 25.4.

California Title 24:

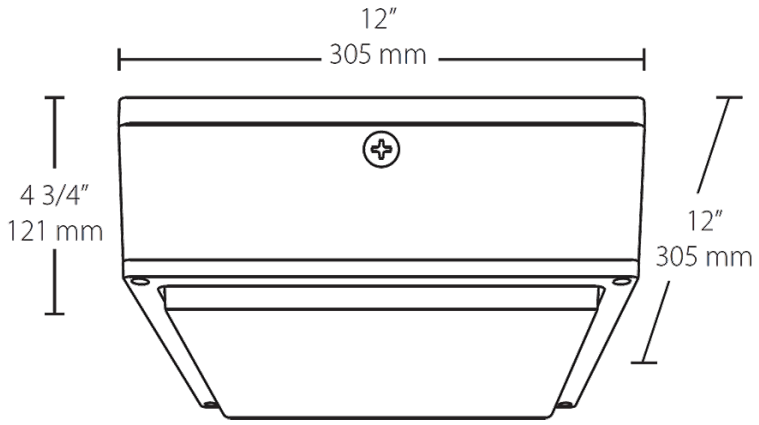
See VANLED20/PCS, VANLED20/PCS2 or VANLED20MS for a 2013 California Title 24 compliant model.

Replacement:

The VANLED 20W replaces up to 70W Metal Halide.

VANLED20W

Dimensions



Features

- Fits the footprint of older canopy lights
- Vandal resistant and UV resistant lens
- Ultra-high efficiency
- Clean, contemporary, low-profile design
- Available with drop lens or flat lens
- IP66 rated, keeps dust, bugs and water out
- Photo and motion sensor options available

Ordering Matrix

Family	Watts	Color Temp	Lens	Finish	Voltage	Dimming
VANLED						
	10 = 10W **20** = 20W **40** = 40W **52** = 52W **65** = 65W **75** = 75W	= Cool **Y** = Warm **N** = Neutral	= Drop lens **F** = Flat lens	= Bronze **W** = White	= 120-277V **/480** = 480V (10W & 20W not available)	= No Dimming **/D10** = Dimmable (10W & 20W not available)

SUBMITTAL

Project

15_smartWatt_WSHP

Date

Wednesday, June 03, 2015

Engineer

Bill Clark

Notes

Looking at replacement for WSHP

Brian W Meneghan

16 Basswood Court
Malta NY 12020

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Unit Report For HP-CCH007C,9C

Project: 15_smartWatt_WSHP
Prepared By: Brian W Meneghan

11/09/2015
12:04AM

Unit Parameters

Tag Name:	**HP-CCH007C,9C**
Quantity:	**1**
Unit Model:	**50PSH**
Unit Size:	**0.5 tons, 300 CFM**
Compressor Type:	**PURON 1-Stage**
Compressor Quantity:	**1**
Configuration:	**Horizontal**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**LOW**

Dimensions

Width:	**23.6**	in
Depth:	**45.9**	in
Height:	**16.8**	in
Shipping Weight:	**185.0**	lb
Operating Weight:	**165.0**	lb
Packaging:	**Domestic**	

Filters

2-in MERV 8 Filter, 15 x 20 (qty 1)

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**17.7**	Amps
Fan FLA:	**.96**	Amps
Min Circuit Amps:	**4**	Amps
Max fuse amps:	**15**	Amps

Corner Weights

Left Front:	**39**	lb
Right Front:	**43**	lb
Left Back:	**39**	lb
Right Back:	**44**	lb

Unit Options

Airflow:	**Right Return, Left Discharge, PSC**
Control Options:	**WSHP Open with C Microprocessor control**
Coil:	**Copper**
Operating Range/Sound Options:	**Standard Range (60 to 95 F) Closed Cell Foam**
Filters:	**Merv 8 Filter**
Valve Options:	**2-Way Solenoid Valve /w Measureflow**

Warranty Information

First Year - Parts Only (Standard):	**No Cost**
Five year compressor – Parts only (standard):	**No Cost**

Notes:

ZS Sensor must be used with WSHP Open to monitor space temperature.

Ordering Information

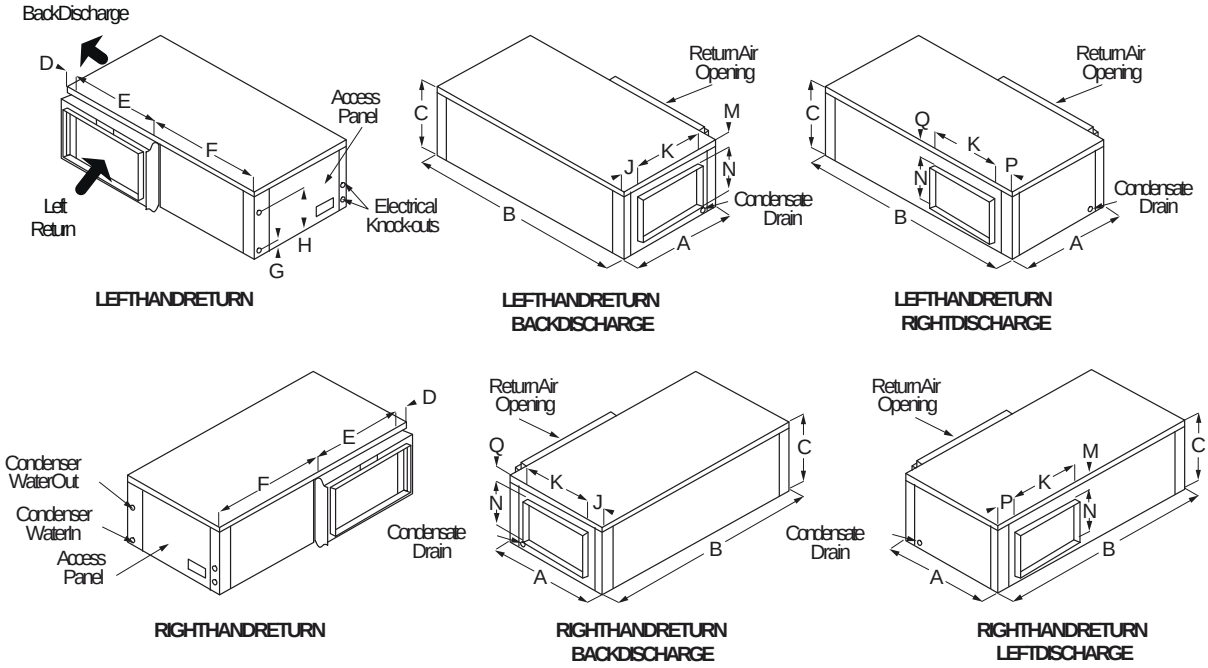
Part Number	Description	Quantity
Base Unit		
50PSH007ZWCCADEY	Commercial Horizontal Puron Single-Stage Water Source Heat Pump 0.5 tons. 300 CFM 208/230-1-60	1
Factory Options		
	Control Options: WSHP Open with C Microprocessor control	
	Operating Range/Sound Options: Standard Range (60 to 95 F) Closed Cell Foam	
	Valve Options: 2-Way Solenoid Valve /w Measureflow	
	Merv 8 Filter	
Accessories		
ZSPL-H-CAR	ZS Plus	1
AHK0752	Stainless Steel Hose Kit, 3/4 in. diameter, 24 in. long	1

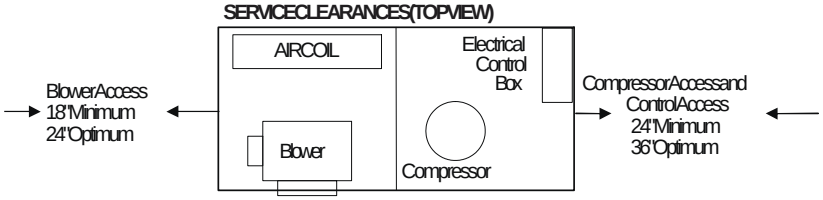
50PSH007-070UNITS

UNIT	A WIDTH	B DEPTH*	C HEIGHT	D CAB END TO FILTER RACK	E R/A DUCT WIDTH	F CAB FRONT TO FILTER RACK	G WATER IN	H WATER OUT	J SIDE TO DISC.	K DISC. WIDTH	M TOP TO DISC.	N DISC. HEIGHT	P END TO DISC.	Q TOP TO DISC.	FILTER RACK HEIGHT	R/A DUCT FLANGE HEIGHT	CONDENSER WATER CONNECTIONS	RECOMMENDED REPLACEMENT NOMINAL FILTER SIZE
007	21.75	43.25	16.75	0.50	20.25	22.25	2.25	13.87	3.50	11.75	4.62	7.75	3.50	4.62	15.00	13.00	3/4 FPT	15 x 20 x 1
009	21.75	43.25	16.75	0.50	20.25	22.25	2.25	13.87	3.50	11.75	4.62	7.75	3.50	4.62	15.00	13.00	3/4 FPT	15 x 20 x 1
012	22.25	45.25	19.75	0.62	20.25	24.25	2.50	12.50	3.62	11.75	7.12	7.75	3.62	4.75	18.00	16.00	3/4 FPT	18 x 20 x 1
015	22.25	45.25	19.75	1.62	20.25	23.25	2.50	12.50	2.75	13.75	3.12	13.75	2.75	2.87	18.00	16.00	3/4 FPT	18 x 20 x 1
018	22.25	45.25	19.75	1.62	20.25	23.25	2.50	12.50	2.75	13.75	3.12	13.75	2.75	2.87	18.00	16.00	3/4 FPT	18 x 20 x 1
024	26.25	54.75	22.00	1.25	30.25	23.00	2.62	15.12	3.75	13.75	2.12	15.75	3.75	4.25	20.12	18.00	3/4 FPT	20 x 30 x 1
030	30.25	68.25	22.00**	2.00	35.00	31.25	2.50	13.25	4.50	15.75	4.00	15.75	4.50	2.25	20.12	18.00	1 FPT	20 x 34.5 x 1
036	30.25	68.25	22.00**	2.00	35.00	31.25	2.50	13.25	4.50	15.75	4.00	15.75	4.50	2.25	20.12	18.00	1 FPT	20 x 34.5 x 1
042	30.25	79.00	22.00**	0.75	48.25	29.62	2.75	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 24 x 1 (2)
048	30.25	79.00	22.00**	0.75	48.25	29.62	2.75	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 24 x 1 (2)
060	30.25	89.25	22.00**	1.87	56.25	31.00	2.62	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 28 x 1 (2)
070	30.25	89.25	22.00**	1.87	56.25	31.00	5.75	17.75	4.87	17.75	2.62	17.75	4.87	1.75	20.12	18.00	1 FPT	20 x 28 x 1 (2)

*When WSHP Open controller is installed increase depth by 2.6 inches.
**Total unit height is 22.75 with base rails for 030-070 units.

NOTES:
1. All dimensions in inches unless otherwise noted. All dimensions within ± 0.125-in. Specifications subject to change without notice.
2. Unit sizes 015-070 discharge locations can be field converted between back discharge and side discharge.
3. Airflow configurations determined when facing panel with water connections.





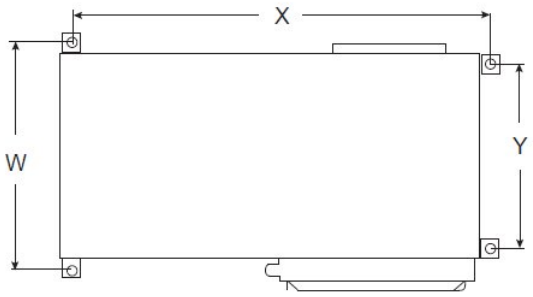
NOTE: The local electric codes may require 36-in. or more clearance at the electrical control box.

50PSH HANGING BRACKET

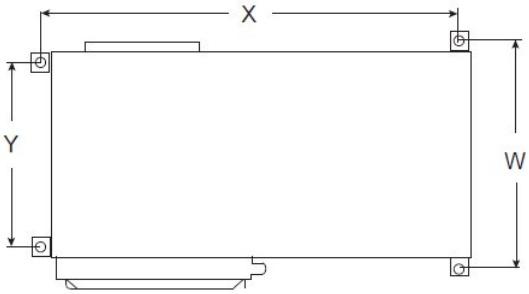
50PSH	W	X	Y
	FRONT	SIDE	BACK
007	23.85	43.08	19.3
009	23.85	43.08	19.3
012	24.35	45.07	19.8
015	24.35	45.07	19.8
018	24.35	45.07	19.8
024	28.35	54.57	23.8
030	32.21	68.07	27.7
036	32.21	68.07	27.7
042	32.21	78.70	27.7
048	32.21	78.70	27.7
060	32.21	89.07	27.7
070	32.21	89.07	27.7

NOTES:
1. Locations are center-to-center of hanging bracket hole.
2. Dimensions are in inches.

TOP VIEW DRAWING
Right Return, Back or Left Discharge

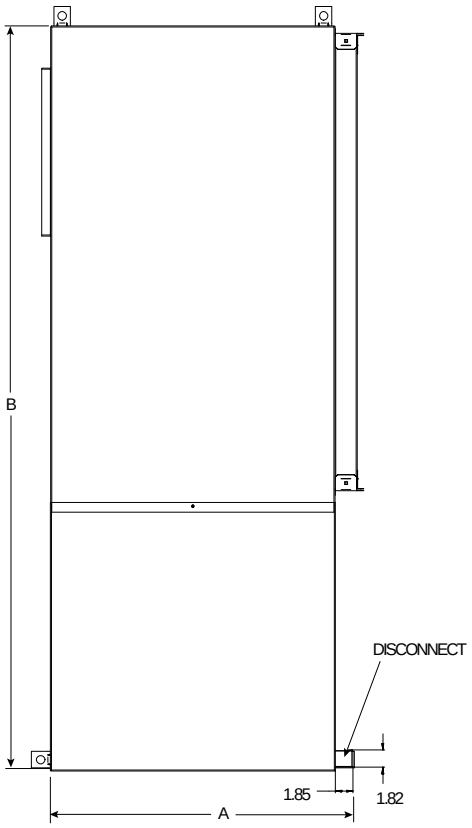


TOP VIEW DRAWING
Left Return, Back or Right Discharge



50PSH WITH FACTORY-INSTALLED DISCONNECT
RIGHT RETURN

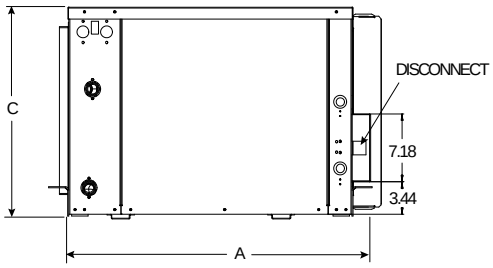
TOP VIEW



50PSH SIZE	WIDTH A	DEPTH B*	HEIGHT C
007	23.6	43.25	16.75
009	23.6	43.25	16.75
012	24.1	45.25	19.75
015	24.1	45.25	19.75
018	24.1	45.25	19.75
024	28.1	54.75	22.00Ž
030	32.1	68.25	22.00Ž
036	32.1	68.25	22.00Ž
042	32.1	79.00	22.00Ž
048	32.1	79.00	22.00Ž
060	32.1	89.25	22.00Ž
070	32.1	89.25	22.00Ž

*If WSHP Open Controller is factory-installed, increase depth by 2.6 inches.
Ž Total unit height is 22.75 with base rails for 030-070 units.
NOTE: Dimensions are shown in inches.

FRONT VIEW



Performance Summary For HP-CCH007C,9C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH007C,9C**	
Quantity:	**1**	
Part Number:	**50PSH007ZWCCADEY**	
Unit Size:	**0.5 tons, 300 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**1.5**	gpm
Fluid Pressure Drop:	**2.9**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.50**	in wg
Filter Air Pressure Drop:	**.08**	in wg
Fan Speed:	**LOW**	

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor Quantity:	**1**	
Compressor LRA:	**17.7**	Amps
Compressor RLA:	**2.5**	Amps
Fan FLA:	**.96**	Amps
Total FLA:	**3.46**	Amps
Max fuse amps:	**15**	Amps
Min Circuit Amps:	**4**	Amps
Min/Max Voltage:	**187/253**	Volts
Fan Power:	**0.117**	kW

Cooling

Airflow:	**285.0**	CFM
Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp:	**80.6**	F
Cooling Ent. Air WB Temp:	**66.2**	F
Total Cooling:	**7.4**	MBH
Sensible Cooling:	**6.5**	MBH
Cooling EER:	**16.8**	Btuh/W
Cooling KW:	**.32**	kW
Heat of Rejection:	**8.3**	MBH
Cooling LAT DB:	**59.4**	F
Cooling LAT WB:	**57.8**	F
Cooling LWT:	**81.1**	F
ARI/ISO 13256-1 WLHP Cooling:	**6.8**	MBH
ARI/ISO 13256-1 WLHP EER:	**15.7**	Btuh/W
ARI/ISO 13256-1 GWHP Cooling:	**8.4**	MBH
ARI/ISO 13256-1 GWHP EER:	**25.1**	Btuh/W
ARI/ISO 13256-1 GLHP Cooling:	**7.4**	MBH
ARI/ISO 13256-1 GLHP EER:	**18.5**	Btuh/W

Heating

Airflow:	**285.0**	CFM
Loop Temp Heating:	**70.0**	F
Heating Ent. Air DB Temp:	**68.0**	F
Heating LAT:	**96.3**	F
Total Heating:	**8.6**	MBH
Heating COP:	**5.0**	
Heating KW:	**.51**	kW
Heat of Absorption:	**7.1**	MBH
Heating LWT:	**60.5**	F
ARI/ISO 13256-1 WLHP Heating:	**8.8**	MBH
ARI/ISO 13256-1 WLHP COP:	**5.7**	
ARI/ISO 13256-1 GWHP Heating:	**7.0**	MBH
ARI/ISO 13256-1 GWHP COP:	**4.9**	
ARI/ISO 13256-1 GLHP Heating:	**5.1**	MBH
ARI/ISO 13256-1 GLHP COP:	**3.6**	

Note

"WLHP" = Water Loop Heat Pump (Boiler/Tower)
"GWHP" = Ground Water Heat Pump (Open Loop)
"GLHP" = Ground Loop Heat Pump (Geothermal)

Acoustics Report For HP-CCH007C,9C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH007C,9C**
Quantity:	**1**
Unit Model:	**50PSH**
Unit Size:	**0.5 tons, 300 CFM**
Compressor Type:	**PURON 1-Stage**
Configuration:	**Horizontal**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**LOW**

Dimensions

Width:	**23.6**	in
Depth:	**45.9**	in
Height:	**16.8**	in
Shipping Weight:	**185.0**	lb

Octave Band Sound Power Level (dB re 1pW)
Standard Construction

Tested in accordance with ARI 260

Mode	Ducted Discharge Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		60	47	51	57	51	45	37	63	59
Heating Full		61	50	51	53	47	46	39	63	56
FAN Only		58	50	51	56	47	46	39	61	58

Mode	Free Inlet Combined w/Casing Radiated Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		64	48	43	42	38	32	27	64	
Heating Full		63	58	44	44	40	34	28	64	
FAN Only		54	43	42	42	37	31	24	55	46

Notes:

All performance is sound power level in dB referenced to 1 picoWatt.
Data based on sound measurements made in a reverberant room on representative units from each cabinet size in accordance with ARI standard 260-2000.

Detailed Performance Report For HP-CCH007C,9C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH007C,9C**	
Quantity:	**1**	
Part Number:	**50PSH007ZWCCADEY**	
Unit Size:	**0.5 tons, 300 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**1.5**	gpm
Fluid Pressure Drop:	**2.9**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.50**	in wg
Filter Air Pressure Drop:	**.08**	in wg

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**17.7**	Amps
Compressor RLA:	**2.5**	Amps
Fan FLA:	**.96**	Amps
Total FLA:	**3.46**	Amps
Max fuse amps:	**15**	Amps
Min Circuit Amps:	**4**	Amps
Min/Max Voltage:	**187/253**	Volts

Design Requirements

Cooling

Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp.:	**80.6**	F
Cooling Ent. Air WB Temp.:	**66.2**	F

Heating

Loop Temp Heating:	**70.0**	F
Heating Ent. air DB Temp.:	**68.0**	F

Fan Configuration

Fan Speed: **LOW**

Cooling

Airflow:	**285.0**	CFM
Total Cooling:	**7.4**	MBH
Sensible Cooling:	**6.5**	MBH
Cooling KW:	**.3**	kW
EER:	**16.8**	Btuh/W
Leaving Air DB Temp.:	**59.4**	F
Leaving Air WB Temp.:	**57.8**	F
Cooling LWT:	**81.1**	F
Heat of Rejection:	**8.3**	MBH

Heating

Airflow:	**285.0**	CFM
Total Heating:	**8.6**	MBH
Heating KW:	**.5**	kW
COP:	**5.0**	
Heating Leaving air Temp.:	**96.3**	F
Heating LWT:	**60.5**	F
Heat of Absorbtion:	**7.1**	MBH

Fan Configuration

Fan Speed: **HI**

Cooling

Airflow:	**335.0**	CFM
Total Cooling:	**7.5**	MBH
Sensible Cooling:	**7.0**	MBH
Cooling KW:	**.3**	kW
EER:	**16.9**	Btuh/W
Leaving Air DB Temp.:	**61.0**	F
Leaving Air WB Temp.:	**59.0**	F
Cooling LWT:	**81.3**	F
Heat of Rejection:	**8.5**	MBH

Heating

Airflow:	**335.0**	CFM
Total Heating:	**8.7**	MBH
Heating KW:	**.5**	kW
COP:	**5.1**	
Heating Leaving air Temp.:	**92.4**	F
Heating LWT:	**60.3**	F
Heat of Absorbtion:	**7.3**	MBH

Fan Configuration

Fan Speed: **MED**

Cooling

Airflow:	**310.0**	CFM
Total Cooling:	**7.5**	MBH
Sensible Cooling:	**6.8**	MBH
Cooling KW:	**.3**	kW
EER:	**16.9**	Btuh/W
Leaving Air DB Temp.:	**60.1**	F
Leaving Air WB Temp.:	**58.4**	F
Cooling LWT:	**81.2**	F
Heat of Rejection:	**8.4**	MBH

Heating

Airflow:	**310.0**	CFM	COP:	**5.1**	
Total Heating:	**8.7**	MBH	Heating Leaving air Temp.:	**94.2**	F
Heating KW:	**.5**	kW	Heating LWT:	**60.4**	F
			Heat of Absorbtion:	**7.2**	MBH

HP-CCH019C

Tag Cover Sheet
Unit Report
Certified Drawing
Performance Report
Acoustic Summary
Detailed Performance Output Report

Unit Report For HP-CCH019C

Project: 15_smartWatt_WSHP
Prepared By: Brian W Meneghan

11/09/2015
12:04AM

Unit Parameters

Tag Name:	**HP-CCH019C**
Quantity:	**1**
Unit Model:	**50PSH**
Unit Size:	**1.5 tons, 600 CFM**
Compressor Type:	**PURON 1-Stage**
Compressor Quantity:	**1**
Configuration:	**Horizontal**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**MED**

Dimensions

Width:	**24.1**	in
Depth:	**47.9**	in
Height:	**19.8**	in
Shipping Weight:	**222.0**	lb
Operating Weight:	**198.0**	lb
Packaging:	**Domestic**	

Filters

2-in MERV 8 Filter, 18 x 20 (qty 1)

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**33.**	Amps
Fan FLA:	**2.8**	Amps
Min Circuit Amps:	**12**	Amps
Max fuse amps:	**15**	Amps

Corner Weights

Left Front:	**51**	lb
Right Front:	**49**	lb
Left Back:	**50**	lb
Right Back:	**48**	lb

Unit Options

Airflow:	**Left Return, Right Discharge, Constant Torque ECM**
Control Options:	**WSHP Open with C Microprocessor control**
Coil:	**Copper**
Operating Range/Sound Options:	**Standard Range (60 to 95 F) Closed Cell Foam**
Filters:	**Merv 8 Filter**
Valve Options:	**2-Way Solenoid Valve /w Measureflow**

Warranty Information

Start-up Each Unit
2nd-5th Year Parts & Labor on complete unit

First Year - Parts Only (Standard):	**No Cost**
Five year compressor – Parts only (standard):	**No Cost**

Notes:

ZS Sensor must be used with WSHP Open to monitor space temperature.

Ordering Information

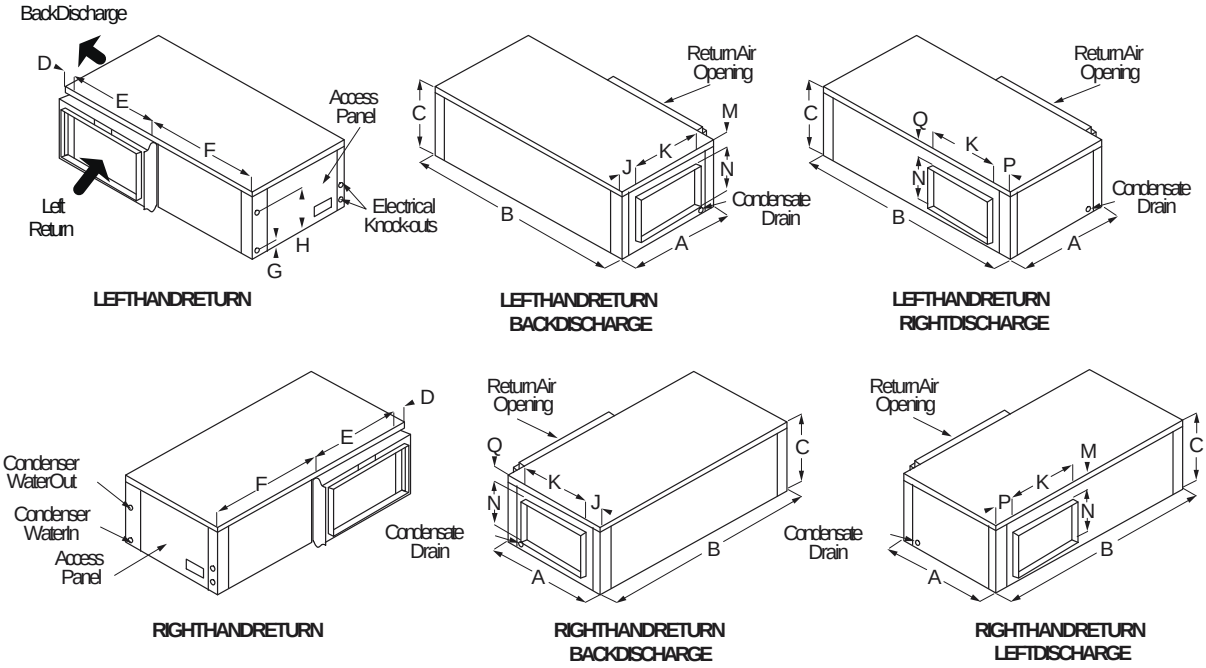
Part Number	Description	Quantity
Base Unit		
50PSH018HWCCADEY	Commercial Horizontal Puron Single-Stage Water Source Heat Pump 1.5 tons. 600 CFM 208/230-1-60	1
Factory Options		
	Control Options: WSHP Open with C Microprocessor control	
	Operating Range/Sound Options: Standard Range (60 to 95 F) Closed Cell Foam	
	Valve Options: 2-Way Solenoid Valve /w Measureflow	
	Merv 8 Filter	
Accessories		
ZS-H-CAR	ZS Standard	1
AHK0752	Stainless Steel Hose Kit, 3/4 in. diameter, 24 in. long	1

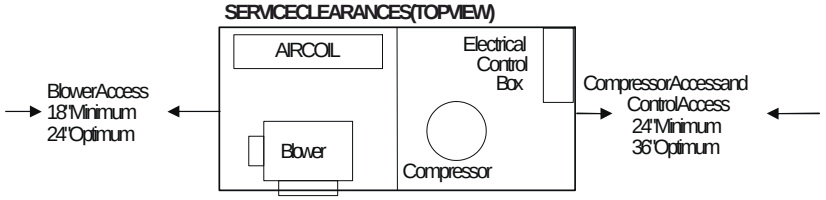
50PSH007-070UNITS

UNIT	A WIDTH	B DEPTH*	C HEIGHT	D CAB END TO FILTER RACK	E R/A DUCT WIDTH	F CAB FRONT TO FILTER RACK	G WATER IN	H WATER OUT	J SIDE TO DISC.	K DISC. WIDTH	M TOP TO DISC.	N DISC. HEIGHT	P END TO DISC.	Q TOP TO DISC.	FILTER RACK HEIGHT	R/A DUCT FLANGE HEIGHT	CONDENSER WATER CONNECTIONS	RECOMMENDED REPLACEMENT NOMINAL FILTER SIZE
007	21.75	43.25	16.75	0.50	20.25	22.25	2.25	13.87	3.50	11.75	4.62	7.75	3.50	4.62	15.00	13.00	3/4 FPT	15 x 20 x 1
009	21.75	43.25	16.75	0.50	20.25	22.25	2.25	13.87	3.50	11.75	4.62	7.75	3.50	4.62	15.00	13.00	3/4 FPT	15 x 20 x 1
012	22.25	45.25	19.75	0.62	20.25	24.25	2.50	12.50	3.62	11.75	7.12	7.75	3.62	4.75	18.00	16.00	3/4 FPT	18 x 20 x 1
015	22.25	45.25	19.75	1.62	20.25	23.25	2.50	12.50	2.75	13.75	3.12	13.75	2.75	2.87	18.00	16.00	3/4 FPT	18 x 20 x 1
018	22.25	45.25	19.75	1.62	20.25	23.25	2.50	12.50	2.75	13.75	3.12	13.75	2.75	2.87	18.00	16.00	3/4 FPT	18 x 20 x 1
024	26.25	54.75	22.00	1.25	30.25	23.00	2.62	15.12	3.75	13.75	2.12	15.75	3.75	4.25	20.12	18.00	3/4 FPT	20 x 30 x 1
030	30.25	68.25	22.00**	2.00	35.00	31.25	2.50	13.25	4.50	15.75	4.00	15.75	4.50	2.25	20.12	18.00	1 FPT	20 x 34.5 x 1
036	30.25	68.25	22.00**	2.00	35.00	31.25	2.50	13.25	4.50	15.75	4.00	15.75	4.50	2.25	20.12	18.00	1 FPT	20 x 34.5 x 1
042	30.25	79.00	22.00**	0.75	48.25	29.62	2.75	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 24 x 1 (2)
048	30.25	79.00	22.00**	0.75	48.25	29.62	2.75	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 24 x 1 (2)
060	30.25	89.25	22.00**	1.87	56.25	31.00	2.62	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 28 x 1 (2)
070	30.25	89.25	22.00**	1.87	56.25	31.00	5.75	17.75	4.87	17.75	2.62	17.75	4.87	1.75	20.12	18.00	1 FPT	20 x 28 x 1 (2)

*When WSHP Open controller is installed increase depth by 2.6 inches.
**Total unit height is 22.75 with base rails for 030-070 units.

NOTES:
1. All dimensions in inches unless otherwise noted. All dimensions within ± 0.125-in. Specifications subject to change without notice.
2. Unit sizes 015-070 discharge locations can be field converted between back discharge and side discharge.
3. Airflow configurations determined when facing panel with water connections.





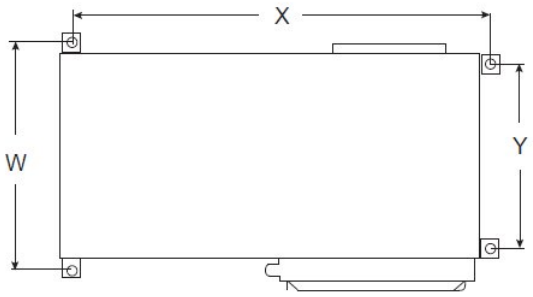
NOTE: The local electric codes may require 36-in. or more clearance at the electrical control box.

50PSH HANGING BRACKET

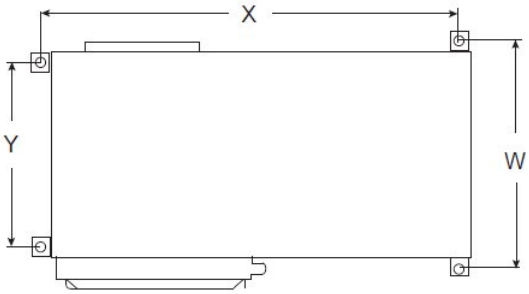
50PSH	W	X	Y
	FRONT	SIDE	BACK
007	23.85	43.08	19.3
009	23.85	43.08	19.3
012	24.35	45.07	19.8
015	24.35	45.07	19.8
018	24.35	45.07	19.8
024	28.35	54.57	23.8
030	32.21	68.07	27.7
036	32.21	68.07	27.7
042	32.21	78.70	27.7
048	32.21	78.70	27.7
060	32.21	89.07	27.7
070	32.21	89.07	27.7

NOTES:
1. Locations are center-to-center of hanging bracket hole.
2. Dimensions are in inches.

TOP VIEW DRAWING
Right Return, Back or Left Discharge

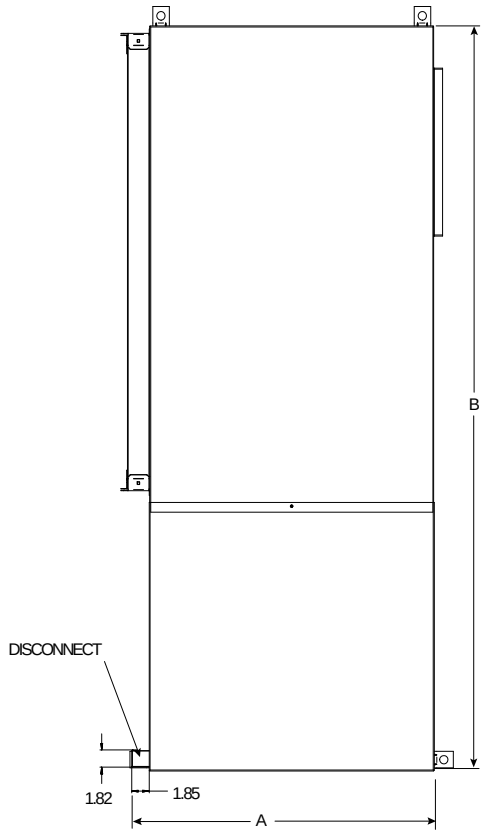


TOP VIEW DRAWING
Left Return, Back or Right Discharge



50PSH WITH FACTORY-INSTALLED DISCONNECT
LEFT RETURN

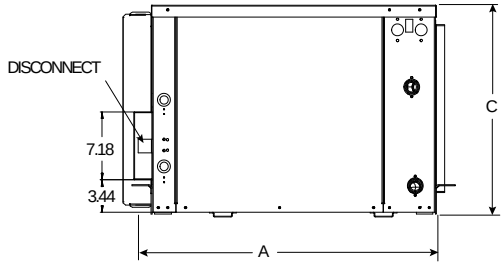
TOP VIEW



50PSH SIZE	WIDTH A	DEPTH B*	HEIGHT C
007	23.6	43.25	16.75
009	23.6	43.25	16.75
012	24.1	45.25	19.75
015	24.1	45.25	19.75
018	24.1	45.25	19.75
024	28.1	54.75	22.00Ž
030	32.1	68.25	22.00Ž
036	32.1	68.25	22.00Ž
042	32.1	79.00	22.00Ž
048	32.1	79.00	22.00Ž
060	32.1	89.25	22.00Ž
070	32.1	89.25	22.00Ž

*If WSHP Open Controller is factory-installed, increase depth by 2.6 inches.
Ž Total unit height is 22.75 with base rails for 024-070 units.
NOTE: Dimensions are shown in inches.

FRONT VIEW



Performance Summary For HP-CCH019C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH019C**	
Quantity:	**1**	
Part Number:	**50PSH018HWCCADEY**	
Unit Size:	**1.5 tons, 600 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**4.5**	gpm
Fluid Pressure Drop:	**8.5**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.14**	in wg
Filter Air Pressure Drop:	**.12**	in wg
Fan Speed:	**MED**	

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor Quantity:	**1**	
Compressor LRA:	**33.**	Amps
Compressor RLA:	**7.4**	Amps
Fan FLA:	**2.8**	Amps
Total FLA:	**10.2**	Amps
Max fuse amps:	**15**	Amps
Min Circuit Amps:	**12**	Amps
Min/Max Voltage:	**187/253**	Volts
Fan Power:	**0.084**	kW

Cooling

Airflow:	**600.0**	CFM
Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp:	**80.6**	F
Cooling Ent. Air WB Temp:	**66.2**	F
Total Cooling:	**20.5**	MBH
Sensible Cooling:	**16.0**	MBH
Cooling EER:	**20.9**	Btuh/W
Cooling KW:	**.90**	kW
Heat of Rejection:	**23.1**	MBH
Cooling LAT DB:	**55.6**	F
Cooling LAT WB:	**54.8**	F
Cooling LWT:	**80.3**	F
ARI/ISO 13256-1 WLHP Cooling:	**19.5**	MBH
ARI/ISO 13256-1 WLHP EER:	**16.4**	Btuh/W
ARI/ISO 13256-1 GWHP Cooling:	**21.3**	MBH
ARI/ISO 13256-1 GWHP EER:	**25.6**	Btuh/W
ARI/ISO 13256-1 GLHP Cooling:	**20.5**	MBH
ARI/ISO 13256-1 GLHP EER:	**19.0**	Btuh/W

Heating

Airflow:	**600.0**	CFM
Loop Temp Heating:	**70.0**	F
Heating Ent. Air DB Temp:	**68.0**	F
Heating LAT:	**102.9**	F
Total Heating:	**22.4**	MBH
Heating COP:	**5.2**	
Heating KW:	**1.25**	kW
Heat of Absorption:	**18.7**	MBH
Heating LWT:	**61.7**	F
ARI/ISO 13256-1 WLHP Heating:	**21.3**	MBH
ARI/ISO 13256-1 WLHP COP:	**5.3**	
ARI/ISO 13256-1 GWHP Heating:	**17.7**	MBH
ARI/ISO 13256-1 GWHP COP:	**4.5**	
ARI/ISO 13256-1 GLHP Heating:	**14.8**	MBH
ARI/ISO 13256-1 GLHP COP:	**3.8**	

Note

"WLHP" = Water Loop Heat Pump (Boiler/Tower)
"GWHP" = Ground Water Heat Pump (Open Loop)
"GLHP" = Ground Loop Heat Pump (Geothermal)

Acoustics Report For HP-CCH019C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH019C**
Quantity:	**1**
Unit Model:	**50PSH**
Unit Size:	**1.5 tons, 600 CFM**
Compressor Type:	**PURON 1-Stage**
Configuration:	**Horizontal**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**MED**

Dimensions

Width:	**24.1**	in
Depth:	**47.9**	in
Height:	**19.8**	in
Shipping Weight:	**222.0**	lb

Octave Band Sound Power Level (dB re 1pW)
Standard Construction

Tested in accordance with ARI 260

Mode	Ducted Discharge Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		69	52	59	57	50	48	39	70	61
Heating Full		70	53	60	57	49	48	39	71	62
FAN Only		62	51	59	58	49	48	39	65	61

Mode	Free Inlet Combined w/Casing Radiated Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		71	62	53	49	47	45	41	72	59
Heating Full		76	66	59	56	55	52	47	77	65
FAN Only		50	48	49	42	35	30	24	54	48

Notes:

All performance is sound power level in dB referenced to 1 picoWatt.
Data based on sound measurements made in a reverberant room on representative units from each cabinet size in accordance with ARI standard 260-2000.

Detailed Performance Report For HP-CCH019C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH019C**	
Quantity:	**1**	
Part Number:	**50PSH018HWCCADEY**	
Unit Size:	**1.5 tons, 600 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**4.5**	gpm
Fluid Pressure Drop:	**8.5**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.50**	in wg
Filter Air Pressure Drop:	**.12**	in wg

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**33.**	Amps
Compressor RLA:	**7.4**	Amps
Fan FLA:	**2.8**	Amps
Total FLA:	**10.2**	Amps
Max fuse amps:	**15**	Amps
Min Circuit Amps:	**12**	Amps
Min/Max Voltage:	**187/253**	Volts

Design Requirements

Cooling

Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp.:	**80.6**	F
Cooling Ent. Air WB Temp.:	**66.2**	F

Heating

Loop Temp Heating:	**70.0**	F
Heating Ent. air DB Temp.:	**68.0**	F

Fan Configuration

Fan Speed: **LOW**

Cooling

Airflow:	**405.0**	CFM
Total Cooling:	**18.9**	MBH
Sensible Cooling:	**13.0**	MBH
Cooling KW:	**.9**	kW
EER:	**18.3**	Btuh/W
Leaving Air DB Temp.:	**50.5**	F
Leaving Air WB Temp.:	**49.9**	F
Cooling LWT:	**79.6**	F
Heat of Rejection:	**21.5**	MBH

Heating

Airflow:	**405.0**	CFM
Total Heating:	**21.6**	MBH
Heating KW:	**1.4**	kW
COP:	**4.4**	
Heating Leaving air Temp.:	**118.0**	F
Heating LWT:	**62.3**	F
Heat of Absorbtion:	**17.4**	MBH

Fan Configuration

Fan Speed: **MED**

Cooling

Airflow:	**460.0**	CFM
Total Cooling:	**19.3**	MBH
Sensible Cooling:	**13.8**	MBH
Cooling KW:	**.9**	kW
EER:	**18.7**	Btuh/W
Leaving Air DB Temp.:	**52.5**	F
Leaving Air WB Temp.:	**51.7**	F
Cooling LWT:	**79.8**	F
Heat of Rejection:	**22.0**	MBH

Heating

Airflow:	**460.0**	CFM
Total Heating:	**21.9**	MBH
Heating KW:	**1.4**	kW
COP:	**4.6**	
Heating Leaving air Temp.:	**112.5**	F
Heating LWT:	**62.1**	F
Heat of Absorbtion:	**17.8**	MBH

Fan Configuration

Fan Speed: **HI**

Cooling

Airflow:	**580.0**	CFM
Total Cooling:	**20.2**	MBH
Sensible Cooling:	**15.6**	MBH
Cooling KW:	**.9**	kW
EER:	**19.5**	Btuh/W
Leaving Air DB Temp.:	**55.5**	F
Leaving Air WB Temp.:	**54.5**	F
Cooling LWT:	**80.2**	F
Heat of Rejection:	**22.9**	MBH

Detailed Performance Report For HP-CCH019C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Heating

Airflow:	**580.0**	CFM	COP:	**5.0**	
Total Heating:	**22.5**	MBH	Heating Leaving air Temp.:	**104.3**	F
Heating KW:	**1.3**	kW	Heating LWT:	**61.7**	F
			Heat of Absorbtion:	**18.6**	MBH

HP-CCH024C

Tag Cover Sheet
Unit Report
Certified Drawing
Performance Report
Acoustic Summary
Detailed Performance Output Report

Unit Report For HP-CCH024C

Project: 15_smartWatt_WSHP
Prepared By: Brian W Meneghan

11/09/2015
12:04AM

Unit Parameters

Tag Name:	**HP-CCH024C**
Quantity:	**1**
Unit Model:	**50PSH**
Unit Size:	**2 tons, 800 CFM**
Compressor Type:	**PURON 1-Stage**
Compressor Quantity:	**1**
Configuration:	**Horizontal**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**MED**

Dimensions

Width:	**28.1**	in
Depth:	**57.4**	in
Height:	**22.8**	in
Shipping Weight:	**340.0**	lb
Operating Weight:	**307.0**	lb
Packaging:	**Domestic**	

Filters

2-in MERV 8 Filter, 20 x 30 (qty 1)

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**58.3**	Amps
Fan FLA:	**2.8**	Amps
Min Circuit Amps:	**20**	Amps
Max fuse amps:	**30**	Amps

Corner Weights

Left Front:	**80**	lb
Right Front:	**78**	lb
Left Back:	**79**	lb
Right Back:	**70**	lb

Unit Options

Airflow:	**Left Return, Right Discharge, Constant Torque ECM**
Control Options:	**WSHP Open with C Microprocessor control**
Coil:	**Copper**
Operating Range/Sound Options:	**Standard Range (60 to 95 F) Closed Cell Foam**
Filters:	**Merv 8 Filter**
Valve Options:	**2-Way Solenoid Valve /w Measureflow**

Warranty Information

First Year - Parts Only (Standard):	**No Cost**
Five year compressor – Parts only (standard):	**No Cost**

Notes:

ZS Sensor must be used with WSHP Open to monitor space temperature.

Ordering Information

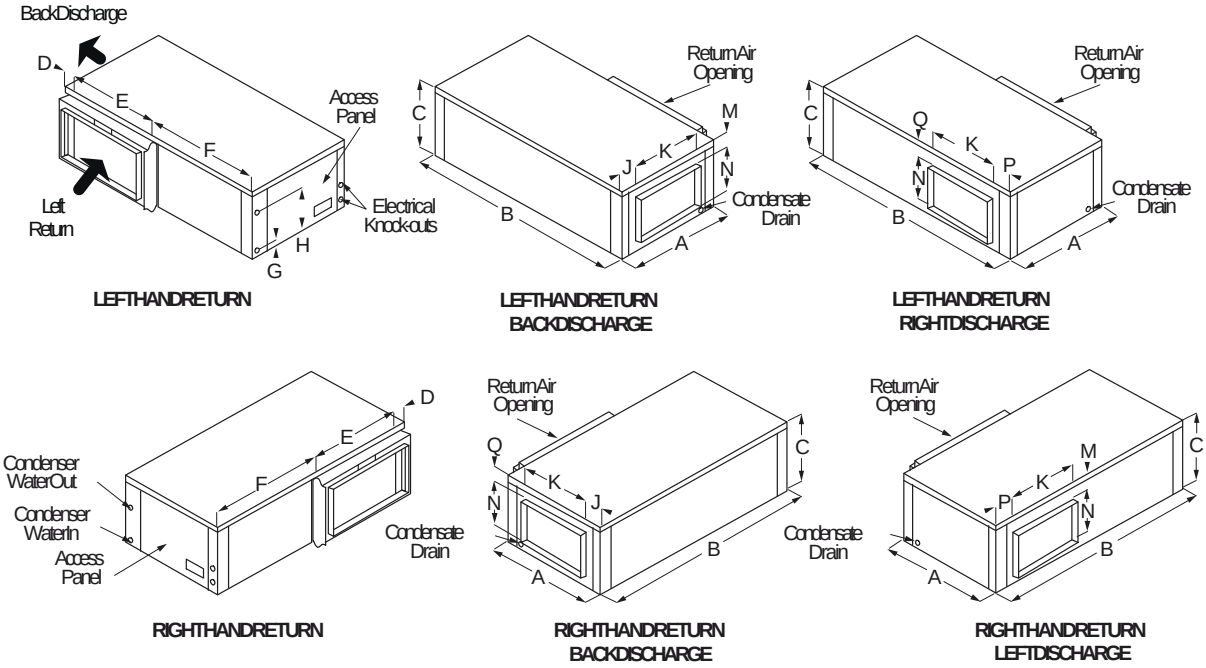
Part Number	Description	Quantity
Base Unit		
50PSH024HWCCADEY	Commercial Horizontal Puron Single-Stage Water Source Heat Pump 2 tons. 800 CFM 208/230-1-60	1
Factory Options		
	Control Options: WSHP Open with C Microprocessor control	
	Operating Range/Sound Options: Standard Range (60 to 95 F) Closed Cell Foam	
	Valve Options: 2-Way Solenoid Valve /w Measureflow	
	Merv 8 Filter	
Accessories		
AHK0752	Stainless Steel Hose Kit, 3/4 in. diameter, 24 in. long	1
ZS-H-CAR	ZS Standard	1

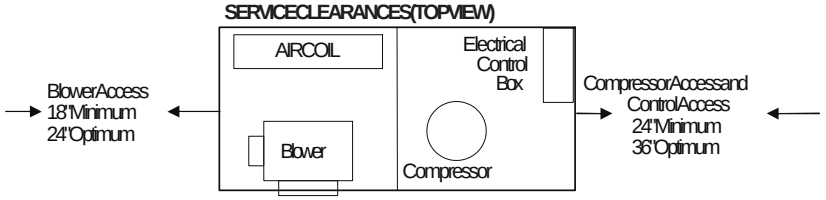
50PSH007-070UNITS

UNIT	A WIDTH	B DEPTH*	C HEIGHT	D CAB END TO FILTER RACK	E R/A DUCT WIDTH	F CAB FRONT TO FILTER RACK	G WATER IN	H WATER OUT	J SIDE TO DISC.	K DISC. WIDTH	M TOP TO DISC.	N DISC. HEIGHT	P END TO DISC.	Q TOP TO DISC.	FILTER RACK HEIGHT	R/A DUCT FLANGE HEIGHT	CONDENSER WATER CONNECTIONS	RECOMMENDED REPLACEMENT NOMINAL FILTER SIZE
007	21.75	43.25	16.75	0.50	20.25	22.25	2.25	13.87	3.50	11.75	4.62	7.75	3.50	4.62	15.00	13.00	3/4 FPT	15 x 20 x 1
009	21.75	43.25	16.75	0.50	20.25	22.25	2.25	13.87	3.50	11.75	4.62	7.75	3.50	4.62	15.00	13.00	3/4 FPT	15 x 20 x 1
012	22.25	45.25	19.75	0.62	20.25	24.25	2.50	12.50	3.62	11.75	7.12	7.75	3.62	4.75	18.00	16.00	3/4 FPT	18 x 20 x 1
015	22.25	45.25	19.75	1.62	20.25	23.25	2.50	12.50	2.75	13.75	3.12	13.75	2.75	2.87	18.00	16.00	3/4 FPT	18 x 20 x 1
018	22.25	45.25	19.75	1.62	20.25	23.25	2.50	12.50	2.75	13.75	3.12	13.75	2.75	2.87	18.00	16.00	3/4 FPT	18 x 20 x 1
024	26.25	54.75	22.00	1.25	30.25	23.00	2.62	15.12	3.75	13.75	2.12	15.75	3.75	4.25	20.12	18.00	3/4 FPT	20 x 30 x 1
030	30.25	68.25	22.00**	2.00	35.00	31.25	2.50	13.25	4.50	15.75	4.00	15.75	4.50	2.25	20.12	18.00	1 FPT	20 x 34.5 x 1
036	30.25	68.25	22.00**	2.00	35.00	31.25	2.50	13.25	4.50	15.75	4.00	15.75	4.50	2.25	20.12	18.00	1 FPT	20 x 34.5 x 1
042	30.25	79.00	22.00**	0.75	48.25	29.62	2.75	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 24 x 1 (2)
048	30.25	79.00	22.00**	0.75	48.25	29.62	2.75	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 24 x 1 (2)
060	30.25	89.25	22.00**	1.87	56.25	31.00	2.62	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 28 x 1 (2)
070	30.25	89.25	22.00**	1.87	56.25	31.00	5.75	17.75	4.87	17.75	2.62	17.75	4.87	1.75	20.12	18.00	1 FPT	20 x 28 x 1 (2)

*When WSHP Open controller is installed increase depth by 2.6 inches.
**Total unit height is 22.75 with base rails for 030-070 units.

NOTES:
1. All dimensions in inches unless otherwise noted. All dimensions within ± 0.125-in. Specifications subject to change without notice.
2. Unit sizes 015-070 discharge locations can be field converted between back discharge and side discharge.
3. Airflow configurations determined when facing panel with water connections.





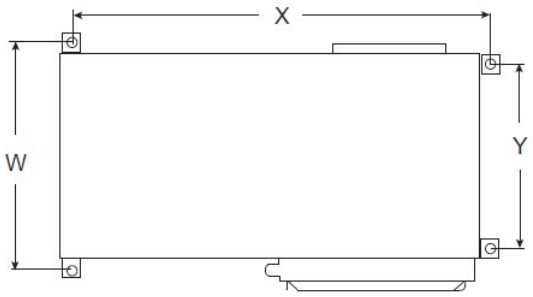
NOTE: The local electric codes may require 36-in. or more clearance at the electrical control box.

50PSH HANGING BRACKET

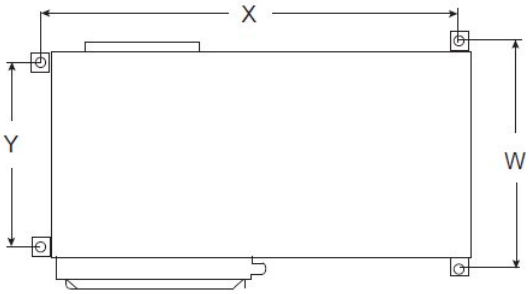
50PSH	W	X	Y
	FRONT	SIDE	BACK
007	23.85	43.08	19.3
009	23.85	43.08	19.3
012	24.35	45.07	19.8
015	24.35	45.07	19.8
018	24.35	45.07	19.8
024	28.35	54.57	23.8
030	32.21	68.07	27.7
036	32.21	68.07	27.7
042	32.21	78.70	27.7
048	32.21	78.70	27.7
060	32.21	89.07	27.7
070	32.21	89.07	27.7

NOTES:
1. Locations are center-to-center of hanging bracket hole.
2. Dimensions are in inches.

TOP VIEW DRAWING
Right Return, Back or Left Discharge

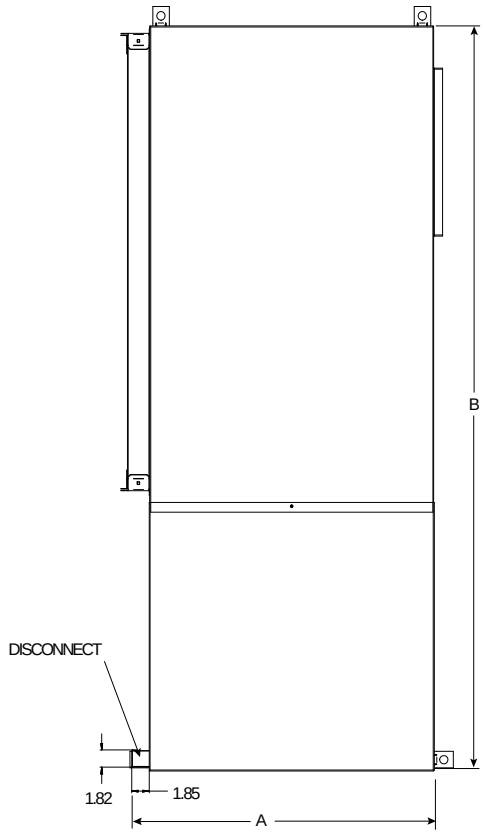


TOP VIEW DRAWING
Left Return, Back or Right Discharge



50PSH WITH FACTORY-INSTALLED DISCONNECT
LEFT RETURN

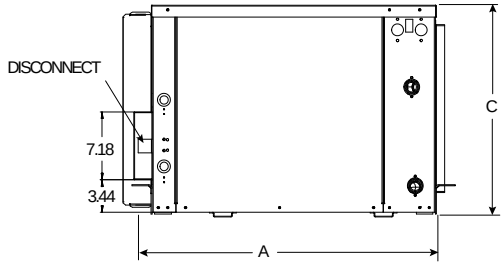
TOP VIEW



50PSH SIZE	WIDTH A	DEPTH B*	HEIGHT C
007	23.6	43.25	16.75
009	23.6	43.25	16.75
012	24.1	45.25	19.75
015	24.1	45.25	19.75
018	24.1	45.25	19.75
024	28.1	54.75	22.00Ž
030	32.1	68.25	22.00Ž
036	32.1	68.25	22.00Ž
042	32.1	79.00	22.00Ž
048	32.1	79.00	22.00Ž
060	32.1	89.25	22.00Ž
070	32.1	89.25	22.00Ž

*If WSHP Open Controller is factory-installed, increase depth by 2.6 inches.
Ž Total unit height is 22.75 with base rails for 024-070 units.
NOTE: Dimensions are shown in inches.

FRONT VIEW



Performance Summary For HP-CCH024C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH024C**	
Quantity:	**1**	
Part Number:	**50PSH024HWCCADEY**	
Unit Size:	**2 tons, 800 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**6.**	gpm
Fluid Pressure Drop:	**6.8**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.47**	in wg
Filter Air Pressure Drop:	**.09**	in wg
Fan Speed:	**MED**	

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor Quantity:	**1**	
Compressor LRA:	**58.3**	Amps
Compressor RLA:	**13.5**	Amps
Fan FLA:	**2.8**	Amps
Total FLA:	**16.3**	Amps
Max fuse amps:	**30**	Amps
Min Circuit Amps:	**20**	Amps
Min/Max Voltage:	**187/253**	Volts
Fan Power:	**0.156**	kW

Cooling

Airflow:	**800.0**	CFM
Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp:	**80.5**	F
Cooling Ent. Air WB Temp:	**66.3**	F
Total Cooling:	**27.5**	MBH
Sensible Cooling:	**21.3**	MBH
Cooling EER:	**22.3**	Btuh/W
Cooling KW:	**1.08**	kW
Heat of Rejection:	**30.6**	MBH
Cooling LAT DB:	**55.6**	F
Cooling LAT WB:	**54.8**	F
Cooling LWT:	**80.2**	F
ARI/ISO 13256-1 WLHP Cooling:	**24.5**	MBH
ARI/ISO 13256-1 WLHP EER:	**18.2**	Btuh/W
ARI/ISO 13256-1 GWHP Cooling:	**28.4**	MBH
ARI/ISO 13256-1 GWHP EER:	**28.1**	Btuh/W
ARI/ISO 13256-1 GLHP Cooling:	**26.0**	MBH
ARI/ISO 13256-1 GLHP EER:	**21.1**	Btuh/W

Heating

Airflow:	**800.0**	CFM
Loop Temp Heating:	**70.0**	F
Heating Ent. Air DB Temp:	**68.0**	F
Heating LAT:	**104.7**	F
Total Heating:	**31.4**	MBH
Heating COP:	**5.4**	
Heating KW:	**1.72**	kW
Heat of Absorption:	**26.4**	MBH
Heating LWT:	**61.2**	F
ARI/ISO 13256-1 WLHP Heating:	**28.5**	MBH
ARI/ISO 13256-1 WLHP COP:	**5.7**	
ARI/ISO 13256-1 GWHP Heating:	**23.7**	MBH
ARI/ISO 13256-1 GWHP COP:	**4.6**	
ARI/ISO 13256-1 GLHP Heating:	**18.0**	MBH
ARI/ISO 13256-1 GLHP COP:	**4.0**	

Note

"WLHP" = Water Loop Heat Pump (Boiler/Tower)
"GWHP" = Ground Water Heat Pump (Open Loop)
"GLHP" = Ground Loop Heat Pump (Geothermal)

Acoustics Report For HP-CCH024C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH024C**
Quantity:	**1**
Unit Model:	**50PSH**
Unit Size:	**2 tons, 800 CFM**
Compressor Type:	**PURON 1-Stage**
Configuration:	**Horizontal**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**MED**

Dimensions

Width:	**28.1**	in
Depth:	**57.4**	in
Height:	**22.8**	in
Shipping Weight:	**340.0**	lb

Octave Band Sound Power Level (dB re 1pW)
Standard Construction

Tested in accordance with ARI 260

Mode	Ducted Discharge Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		70	55	63	52	51	54	43	71	62
Heating Full		73	56	63	54	50	53	42	74	63
FAN Only		66	55	63	52	50	53	43	68	62

Mode	Free Inlet Combined w/Casing Radiated Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		63	55	54	49	42	37	28	65	55
Heating Full		71	56	54	50	44	41	32	72	58
FAN Only		55	52	53	49	42	38	27	59	54

Notes:

All performance is sound power level in dB referenced to 1 picoWatt.
Data based on sound measurements made in a reverberant room on representative units from each cabinet size in accordance with ARI standard 260-2000.

Detailed Performance Report For HP-CCH024C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH024C**	
Quantity:	**1**	
Part Number:	**50PSH024HWCCADEY**	
Unit Size:	**2 tons, 800 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**6.**	gpm
Fluid Pressure Drop:	**6.8**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.50**	in wg
Filter Air Pressure Drop:	**.09**	in wg

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**58.3**	Amps
Compressor RLA:	**13.5**	Amps
Fan FLA:	**2.8**	Amps
Total FLA:	**16.3**	Amps
Max fuse amps:	**30**	Amps
Min Circuit Amps:	**20**	Amps
Min/Max Voltage:	**187/253**	Volts

Design Requirements

Cooling

Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp.:	**80.5**	F
Cooling Ent. Air WB Temp.:	**66.3**	F

Heating

Loop Temp Heating:	**70.0**	F
Heating Ent. air DB Temp.:	**68.0**	F

Fan Configuration

Fan Speed: **LOW**

Cooling

Airflow:	**585.0**	CFM
Total Cooling:	**25.9**	MBH
Sensible Cooling:	**18.1**	MBH
Cooling KW:	**1.1**	kW
EER:	**21.4**	Btuh/W
Leaving Air DB Temp.:	**51.6**	F
Leaving Air WB Temp.:	**50.9**	F
Cooling LWT:	**79.7**	F
Heat of Rejection:	**29.0**	MBH

Heating

Airflow:	**585.0**	CFM
Total Heating:	**30.5**	MBH
Heating KW:	**1.9**	kW
COP:	**4.6**	
Heating Leaving air Temp.:	**116.8**	F
Heating LWT:	**61.7**	F
Heat of Absorbtion:	**24.9**	MBH

Fan Configuration

Fan Speed: **MED**

Cooling

Airflow:	**790.0**	CFM
Total Cooling:	**27.4**	MBH
Sensible Cooling:	**21.1**	MBH
Cooling KW:	**1.1**	kW
EER:	**22.1**	Btuh/W
Leaving Air DB Temp.:	**55.5**	F
Leaving Air WB Temp.:	**54.7**	F
Cooling LWT:	**80.2**	F
Heat of Rejection:	**30.5**	MBH

Heating

Airflow:	**790.0**	CFM
Total Heating:	**31.4**	MBH
Heating KW:	**1.7**	kW
COP:	**5.3**	
Heating Leaving air Temp.:	**105.1**	F
Heating LWT:	**61.2**	F
Heat of Absorbtion:	**26.3**	MBH

Fan Configuration

Fan Speed: **HI**

Cooling

Airflow:	**855.0**	CFM
Total Cooling:	**27.7**	MBH
Sensible Cooling:	**22.1**	MBH
Cooling KW:	**1.1**	kW
EER:	**22.2**	Btuh/W
Leaving Air DB Temp.:	**56.4**	F
Leaving Air WB Temp.:	**55.5**	F
Cooling LWT:	**80.3**	F
Heat of Rejection:	**30.8**	MBH

Detailed Performance Report For HP-CCH024C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Heating

Airflow:	**855.0**	CFM	COP:	**5.4**	
Total Heating:	**31.5**	MBH	Heating Leaving air Temp.:	**102.5**	F
Heating KW:	**1.7**	kW	Heating LWT:	**61.2**	F
			Heat of Absorbtion:	**26.5**	MBH

HP-CCH030C

Tag Cover Sheet
Unit Report
Certified Drawing
Performance Report
Acoustic Summary
Detailed Performance Output Report

Unit Report For HP-CCH030C

Project: 15_smartWatt_WSHP
Prepared By: Brian W Meneghan

11/09/2015
12:04AM

Unit Parameters

Tag Name:	**HP-CCH030C**
Quantity:	**1**
Unit Model:	**50PSH**
Unit Size:	**2.5 tons, 1000 CFM**
Compressor Type:	**PURON 1-Stage**
Compressor Quantity:	**1**
Configuration:	**Horizontal**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**MED**

Dimensions

Width:	**32.1**	in
Depth:	**70.9**	in
Height:	**22.8**	in
Shipping Weight:	**404.0**	lb
Operating Weight:	**358.0**	lb
Packaging:	**Domestic**	

Filters

2-in MERV 8 Filter, 20 x 34.5 (qty 1)

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**58.3**	Amps
Fan FLA:	**4.1**	Amps
Min Circuit Amps:	**20**	Amps
Max fuse amps:	**30**	Amps

Corner Weights

Left Front:	**99**	lb
Right Front:	**88**	lb
Left Back:	**92**	lb
Right Back:	**79**	lb

Unit Options

Airflow:	**Left Return, Right Discharge, Constant Torque ECM**
Control Options:	**WSHP Open with C Microprocessor control**
Coil:	**Copper**
Operating Range/Sound Options:	**Standard Range (60 to 95 F) Closed Cell Foam**
Filters:	**Merv 8 Filter**
Valve Options:	**2-Way Solenoid Valve /w Measureflow**

Warranty Information

Start-up Each Unit
2nd-5th Year Parts & Labor on complete unit

First Year - Parts Only (Standard):	**No Cost**
Five year compressor – Parts only (standard):	**No Cost**

Notes:

ZS Sensor must be used with WSHP Open to monitor space temperature.

Ordering Information

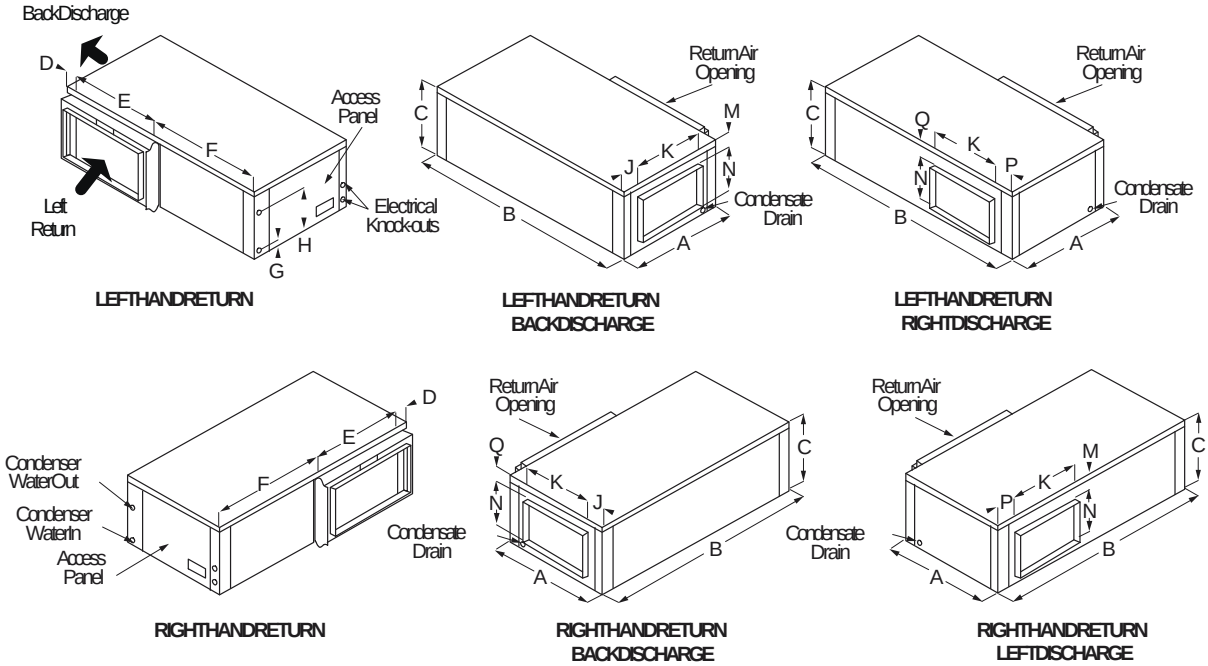
Part Number	Description	Quantity
Base Unit		
50PSH030HWCCADEY	Commercial Horizontal Puron Single-Stage Water Source Heat Pump 2.5 tons. 1000 CFM 208/230-1-60	1
Factory Options		
	Control Options: WSHP Open with C Microprocessor control	
	Operating Range/Sound Options: Standard Range (60 to 95 F) Closed Cell Foam	
	Valve Options: 2-Way Solenoid Valve /w Measureflow	
	Merv 8 Filter	
Accessories		
AHK1002	Stainless Steel Hose Kit, 1 in. diameter, 24 in. long	1
ZS-H-CAR	ZS Standard	1

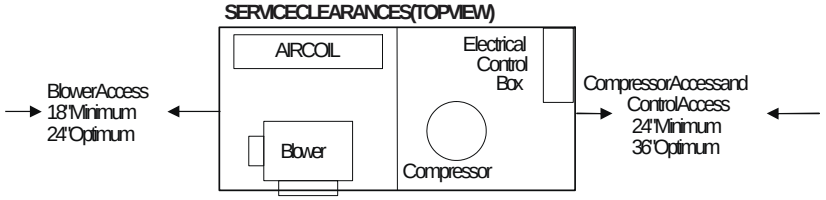
50PSH007-070UNITS

UNIT	A WIDTH	B DEPTH*	C HEIGHT	D CAB END TO FILTER RACK	E R/A DUCT WIDTH	F CAB FRONT TO FILTER RACK	G WATER IN	H WATER OUT	J SIDE TO DISC.	K DISC. WIDTH	M TOP TO DISC.	N DISC. HEIGHT	P END TO DISC.	Q TOP TO DISC.	FILTER RACK HEIGHT	R/A DUCT FLANGE HEIGHT	CONDENSER WATER CONNECTIONS	RECOMMENDED REPLACEMENT NOMINAL FILTER SIZE
007	21.75	43.25	16.75	0.50	20.25	22.25	2.25	13.87	3.50	11.75	4.62	7.75	3.50	4.62	15.00	13.00	3/4 FPT	15 x 20 x 1
009	21.75	43.25	16.75	0.50	20.25	22.25	2.25	13.87	3.50	11.75	4.62	7.75	3.50	4.62	15.00	13.00	3/4 FPT	15 x 20 x 1
012	22.25	45.25	19.75	0.62	20.25	24.25	2.50	12.50	3.62	11.75	7.12	7.75	3.62	4.75	18.00	16.00	3/4 FPT	18 x 20 x 1
015	22.25	45.25	19.75	1.62	20.25	23.25	2.50	12.50	2.75	13.75	3.12	13.75	2.75	2.87	18.00	16.00	3/4 FPT	18 x 20 x 1
018	22.25	45.25	19.75	1.62	20.25	23.25	2.50	12.50	2.75	13.75	3.12	13.75	2.75	2.87	18.00	16.00	3/4 FPT	18 x 20 x 1
024	26.25	54.75	22.00	1.25	30.25	23.00	2.62	15.12	3.75	13.75	2.12	15.75	3.75	4.25	20.12	18.00	3/4 FPT	20 x 30 x 1
030	30.25	68.25	22.00**	2.00	35.00	31.25	2.50	13.25	4.50	15.75	4.00	15.75	4.50	2.25	20.12	18.00	1 FPT	20 x 34.5 x 1
036	30.25	68.25	22.00**	2.00	35.00	31.25	2.50	13.25	4.50	15.75	4.00	15.75	4.50	2.25	20.12	18.00	1 FPT	20 x 34.5 x 1
042	30.25	79.00	22.00**	0.75	48.25	29.62	2.75	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 24 x 1 (2)
048	30.25	79.00	22.00**	0.75	48.25	29.62	2.75	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 24 x 1 (2)
060	30.25	89.25	22.00**	1.87	56.25	31.00	2.62	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 28 x 1 (2)
070	30.25	89.25	22.00**	1.87	56.25	31.00	5.75	17.75	4.87	17.75	2.62	17.75	4.87	1.75	20.12	18.00	1 FPT	20 x 28 x 1 (2)

*When WSHP Open controller is installed increase depth by 2.6 inches.
**Total unit height is 22.75 with base rails for 030-070 units.

NOTES:
1. All dimensions in inches unless otherwise noted. All dimensions within ± 0.125-in. Specifications subject to change without notice.
2. Unit sizes 015-070 discharge locations can be field converted between back discharge and side discharge.
3. Airflow configurations determined when facing panel with water connections.





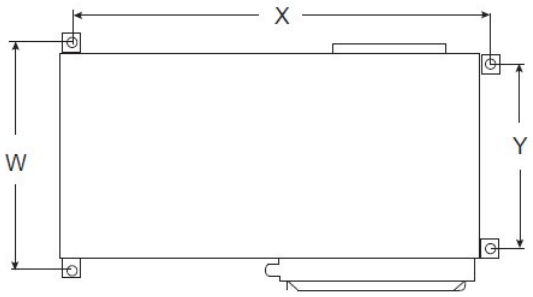
NOTE: The local electric codes may require 36-in. or more clearance at the electrical control box.

50PSH HANGING BRACKET

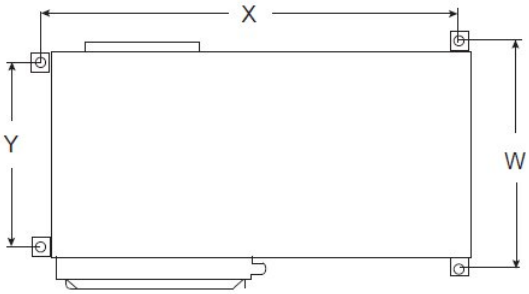
50PSH	W	X	Y
	FRONT	SIDE	BACK
007	23.85	43.08	19.3
009	23.85	43.08	19.3
012	24.35	45.07	19.8
015	24.35	45.07	19.8
018	24.35	45.07	19.8
024	28.35	54.57	23.8
030	32.21	68.07	27.7
036	32.21	68.07	27.7
042	32.21	78.70	27.7
048	32.21	78.70	27.7
060	32.21	89.07	27.7
070	32.21	89.07	27.7

NOTES:
1. Locations are center-to-center of hanging bracket hole.
2. Dimensions are in inches.

TOP VIEW DRAWING
Right Return, Back or Left Discharge

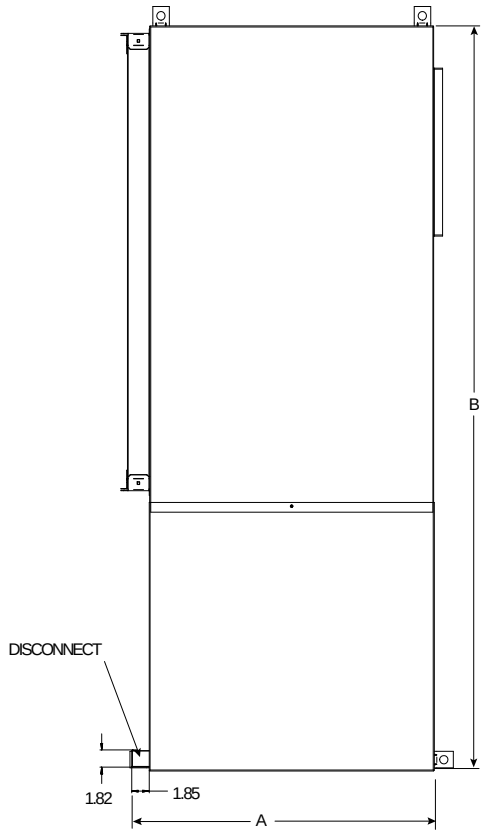


TOP VIEW DRAWING
Left Return, Back or Right Discharge



50PSH WITH FACTORY-INSTALLED DISCONNECT
LEFT RETURN

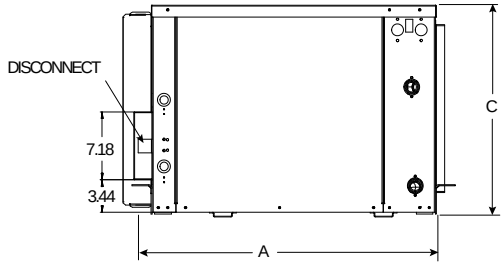
TOP VIEW



50PSH SIZE	WIDTH A	DEPTH B*	HEIGHT C
007	23.6	43.25	16.75
009	23.6	43.25	16.75
012	24.1	45.25	19.75
015	24.1	45.25	19.75
018	24.1	45.25	19.75
024	28.1	54.75	22.00Ž
030	32.1	68.25	22.00Ž
036	32.1	68.25	22.00Ž
042	32.1	79.00	22.00Ž
048	32.1	79.00	22.00Ž
060	32.1	89.25	22.00Ž
070	32.1	89.25	22.00Ž

*If WSHP Open Controller is factory-installed, increase depth by 2.6 inches.
Ž Total unit height is 22.75 with base rails for 024-070 units.
NOTE: Dimensions are shown in inches.

FRONT VIEW



Performance Summary For HP-CCH030C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH030C**	
Quantity:	**1**	
Part Number:	**50PSH030HWCCADEY**	
Unit Size:	**2.5 tons, 1000 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**7.5**	gpm
Fluid Pressure Drop:	**3.6**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.45**	in wg
Filter Air Pressure Drop:	**.09**	in wg
Fan Speed:	**MED**	

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor Quantity:	**1**	
Compressor LRA:	**58.3**	Amps
Compressor RLA:	**12.8**	Amps
Fan FLA:	**4.1**	Amps
Total FLA:	**16.9**	Amps
Max fuse amps:	**30**	Amps
Min Circuit Amps:	**20**	Amps
Min/Max Voltage:	**187/253**	Volts
Fan Power:	**0.24**	kW

Cooling

Airflow:	**1,000.0**	CFM
Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp:	**80.6**	F
Cooling Ent. Air WB Temp:	**66.3**	F
Total Cooling:	**30.4**	MBH
Sensible Cooling:	**24.9**	MBH
Cooling EER:	**20.7**	Btuh/W
Cooling KW:	**1.23**	kW
Heat of Rejection:	**34.0**	MBH
Cooling LAT DB:	**57.3**	F
Cooling LAT WB:	**56.2**	F
Cooling LWT:	**79.1**	F
ARI/ISO 13256-1 WLHP Cooling:	**27.0**	MBH
ARI/ISO 13256-1 WLHP EER:	**16.6**	Btuh/W
ARI/ISO 13256-1 GWHP Cooling:	**31.7**	MBH
ARI/ISO 13256-1 GWHP EER:	**27.0**	Btuh/W
ARI/ISO 13256-1 GLHP Cooling:	**28.5**	MBH
ARI/ISO 13256-1 GLHP EER:	**19.4**	Btuh/W

Heating

Airflow:	**1,000.0**	CFM
Loop Temp Heating:	**70.0**	F
Heating Ent. Air DB Temp:	**68.0**	F
Heating LAT:	**99.6**	F
Total Heating:	**33.8**	MBH
Heating COP:	**5.7**	
Heating KW:	**1.73**	kW
Heat of Absorption:	**28.7**	MBH
Heating LWT:	**62.3**	F
ARI/ISO 13256-1 WLHP Heating:	**31.0**	MBH
ARI/ISO 13256-1 WLHP COP:	**5.9**	
ARI/ISO 13256-1 GWHP Heating:	**25.0**	MBH
ARI/ISO 13256-1 GWHP COP:	**5.2**	
ARI/ISO 13256-1 GLHP Heating:	**20.5**	MBH
ARI/ISO 13256-1 GLHP COP:	**4.3**	

Note

"WLHP" = Water Loop Heat Pump (Boiler/Tower)
"GWHP" = Ground Water Heat Pump (Open Loop)
"GLHP" = Ground Loop Heat Pump (Geothermal)

Acoustics Report For HP-CCH030C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH030C**
Quantity:	**1**
Unit Model:	**50PSH**
Unit Size:	**2.5 tons, 1000 CFM**
Compressor Type:	**PURON 1-Stage**
Configuration:	**Horizontal**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**MED**

Dimensions

Width:	**32.1**	in
Depth:	**70.9**	in
Height:	**22.8**	in
Shipping Weight:	**404.0**	lb

Octave Band Sound Power Level (dB re 1pW)
Standard Construction

Tested in accordance with ARI 260

Mode	Ducted Discharge Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		70	55	63	52	51	54	43	71	62
Heating Full		73	56	63	54	50	53	42	74	63
FAN Only		66	55	63	52	50	53	43	68	62

Mode	Free Inlet Combined w/Casing Radiated Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		67	58	56	52	45	38	28	68	58
Heating Full		67	58	66	52	46	39	30	68	58
FAN Only		58	55	56	52	45	38	26	62	56

Notes:

All performance is sound power level in dB referenced to 1 picoWatt.
Data based on sound measurements made in a reverberant room on representative units from each cabinet size in accordance with ARI standard 260-2000.

Detailed Performance Report For HP-CCH030C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH030C**	
Quantity:	**1**	
Part Number:	**50PSH030HWCCADEY**	
Unit Size:	**2.5 tons, 1000 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**7.5**	gpm
Fluid Pressure Drop:	**3.6**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.50**	in wg
Filter Air Pressure Drop:	**.09**	in wg

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**58.3**	Amps
Compressor RLA:	**12.8**	Amps
Fan FLA:	**4.1**	Amps
Total FLA:	**16.9**	Amps
Max fuse amps:	**30**	Amps
Min Circuit Amps:	**20**	Amps
Min/Max Voltage:	**187/253**	Volts

Design Requirements

Cooling

Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp.:	**80.6**	F
Cooling Ent. Air WB Temp.:	**66.3**	F

Heating

Loop Temp Heating:	**70.0**	F
Heating Ent. air DB Temp.:	**68.0**	F

Fan Configuration

Fan Speed: **LOW**

Cooling

Airflow:	**825.0**	CFM
Total Cooling:	**29.3**	MBH
Sensible Cooling:	**22.4**	MBH
Cooling KW:	**1.2**	kW
EER:	**20.3**	Btuh/W
Leaving Air DB Temp.:	**55.2**	F
Leaving Air WB Temp.:	**54.3**	F
Cooling LWT:	**78.8**	F
Heat of Rejection:	**32.9**	MBH

Heating

Airflow:	**825.0**	CFM
Total Heating:	**33.4**	MBH
Heating KW:	**1.9**	kW
COP:	**5.2**	
Heating Leaving air Temp.:	**105.8**	F
Heating LWT:	**62.6**	F
Heat of Absorbtion:	**27.9**	MBH

Fan Configuration

Fan Speed: **MED**

Cooling

Airflow:	**985.0**	CFM
Total Cooling:	**30.2**	MBH
Sensible Cooling:	**24.6**	MBH
Cooling KW:	**1.2**	kW
EER:	**20.4**	Btuh/W
Leaving Air DB Temp.:	**57.2**	F
Leaving Air WB Temp.:	**56.1**	F
Cooling LWT:	**79.0**	F
Heat of Rejection:	**33.8**	MBH

Heating

Airflow:	**985.0**	CFM
Total Heating:	**33.8**	MBH
Heating KW:	**1.8**	kW
COP:	**5.6**	
Heating Leaving air Temp.:	**100.1**	F
Heating LWT:	**62.4**	F
Heat of Absorbtion:	**28.6**	MBH

Fan Configuration

Fan Speed: **HI**

Cooling

Airflow:	**1,110.0**	CFM
Total Cooling:	**30.7**	MBH
Sensible Cooling:	**26.4**	MBH
Cooling KW:	**1.2**	kW
EER:	**20.4**	Btuh/W
Leaving Air DB Temp.:	**58.3**	F
Leaving Air WB Temp.:	**57.2**	F
Cooling LWT:	**79.2**	F
Heat of Rejection:	**34.3**	MBH

Detailed Performance Report For HP-CCH030C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Heating

Airflow:	**1,110.0**	CFM	COP:	**5.7**	
Total Heating:	**34.0**	MBH	Heating Leaving air Temp.:	**96.7**	F
Heating KW:	**1.7**	kW	Heating LWT:	**62.3**	F
			Heat of Absorbtion:	**28.9**	MBH

HP-CCH036C

Tag Cover Sheet
Unit Report
Certified Drawing
Performance Report
Acoustic Summary
Detailed Performance Output Report

Unit Report For HP-CCH036C

Project: 15_smartWatt_WSHP
Prepared By: Brian W Meneghan

11/09/2015
12:04AM

Unit Parameters

Tag Name:	**HP-CCH036C**
Quantity:	**1**
Unit Model:	**50PSH**
Unit Size:	**3 tons, 1200 CFM**
Compressor Type:	**PURON 1-Stage**
Compressor Quantity:	**1**
Configuration:	**Horizontal**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**MED**

Dimensions

Width:	**32.1**	in
Depth:	**70.9**	in
Height:	**22.8**	in
Shipping Weight:	**415.0**	lb
Operating Weight:	**369.0**	lb
Packaging:	**Domestic**	

Filters

2-in MERV 8 Filter, 20 x 34.5 (qty 1)

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**77.**	Amps
Fan FLA:	**6.**	Amps
Min Circuit Amps:	**26**	Amps
Max fuse amps:	**40**	Amps

Corner Weights

Left Front:	**100**	lb
Right Front:	**92**	lb
Left Back:	**94**	lb
Right Back:	**83**	lb

Unit Options

Airflow:	**Left Return, Right Discharge, Constant Torque ECM**
Control Options:	**WSHP Open with C Microprocessor control**
Coil:	**Copper**
Operating Range/Sound Options:	**Standard Range (60 to 95 F) Closed Cell Foam**
Filters:	**Merv 8 Filter**
Valve Options:	**2-Way Solenoid Valve /w Measureflow**

Warranty Information

First Year - Parts Only (Standard):	**No Cost**
Five year compressor – Parts only (standard):	**No Cost**

Notes:

ZS Sensor must be used with WSHP Open to monitor space temperature.

Ordering Information

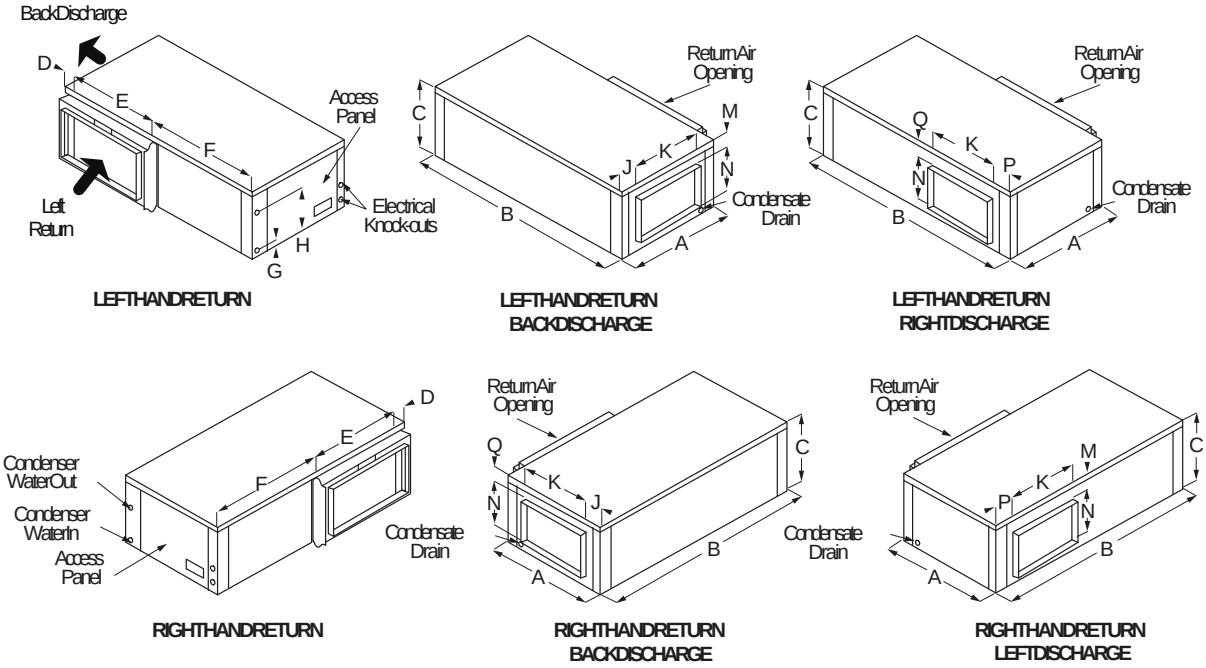
Part Number	Description	Quantity
Base Unit		
50PSH036HWCCADEY	Commercial Horizontal Puron Single-Stage Water Source Heat Pump 3 tons. 1200 CFM 208/230-1-60	1
Factory Options		
	Control Options: WSHP Open with C Microprocessor control	
	Operating Range/Sound Options: Standard Range (60 to 95 F) Closed Cell Foam	
	Valve Options: 2-Way Solenoid Valve /w Measureflow	
	Merv 8 Filter	
Accessories		
AHK1002	Stainless Steel Hose Kit, 1 in. diameter, 24 in. long	1
ZS-H-CAR	ZS Standard	1

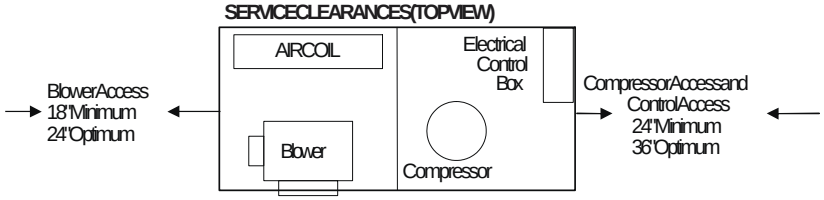
50PSH007-070UNITS

UNIT	A WIDTH	B DEPTH*	C HEIGHT	D CAB END TO FILTER RACK	E R/A DUCT WIDTH	F CAB FRONT TO FILTER RACK	G WATER IN	H WATER OUT	J SIDE TO DISC.	K DISC. WIDTH	M TOP TO DISC.	N DISC. HEIGHT	P END TO DISC.	Q TOP TO DISC.	FILTER RACK HEIGHT	R/A DUCT FLANGE HEIGHT	CONDENSER WATER CONNECTIONS	RECOMMENDED REPLACEMENT NOMINAL FILTER SIZE
007	21.75	43.25	16.75	0.50	20.25	22.25	2.25	13.87	3.50	11.75	4.62	7.75	3.50	4.62	15.00	13.00	3/4 FPT	15 x 20 x 1
009	21.75	43.25	16.75	0.50	20.25	22.25	2.25	13.87	3.50	11.75	4.62	7.75	3.50	4.62	15.00	13.00	3/4 FPT	15 x 20 x 1
012	22.25	45.25	19.75	0.62	20.25	24.25	2.50	12.50	3.62	11.75	7.12	7.75	3.62	4.75	18.00	16.00	3/4 FPT	18 x 20 x 1
015	22.25	45.25	19.75	1.62	20.25	23.25	2.50	12.50	2.75	13.75	3.12	13.75	2.75	2.87	18.00	16.00	3/4 FPT	18 x 20 x 1
018	22.25	45.25	19.75	1.62	20.25	23.25	2.50	12.50	2.75	13.75	3.12	13.75	2.75	2.87	18.00	16.00	3/4 FPT	18 x 20 x 1
024	26.25	54.75	22.00	1.25	30.25	23.00	2.62	15.12	3.75	13.75	2.12	15.75	3.75	4.25	20.12	18.00	3/4 FPT	20 x 30 x 1
030	30.25	68.25	22.00**	2.00	35.00	31.25	2.50	13.25	4.50	15.75	4.00	15.75	4.50	2.25	20.12	18.00	1 FPT	20 x 34.5 x 1
036	30.25	68.25	22.00**	2.00	35.00	31.25	2.50	13.25	4.50	15.75	4.00	15.75	4.50	2.25	20.12	18.00	1 FPT	20 x 34.5 x 1
042	30.25	79.00	22.00**	0.75	48.25	29.62	2.75	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 24 x 1 (2)
048	30.25	79.00	22.00**	0.75	48.25	29.62	2.75	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 24 x 1 (2)
060	30.25	89.25	22.00**	1.87	56.25	31.00	2.62	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 28 x 1 (2)
070	30.25	89.25	22.00**	1.87	56.25	31.00	5.75	17.75	4.87	17.75	2.62	17.75	4.87	1.75	20.12	18.00	1 FPT	20 x 28 x 1 (2)

*When WSHP Open controller is installed increase depth by 2.6 inches.
**Total unit height is 22.75 with base rails for 030-070 units.

NOTES:
1. All dimensions in inches unless otherwise noted. All dimensions within ± 0.125-in. Specifications subject to change without notice.
2. Unit sizes 015-070 discharge locations can be field converted between back discharge and side discharge.
3. Airflow configurations determined when facing panel with water connections.





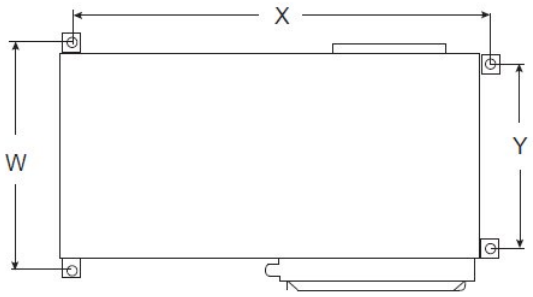
NOTE: The local electric codes may require 36-in. or more clearance at the electrical control box.

50PSH HANGING BRACKET

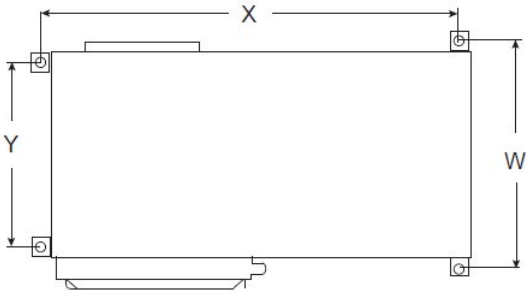
50PSH	W	X	Y
	FRONT	SIDE	BACK
007	23.85	43.08	19.3
009	23.85	43.08	19.3
012	24.35	45.07	19.8
015	24.35	45.07	19.8
018	24.35	45.07	19.8
024	28.35	54.57	23.8
030	32.21	68.07	27.7
036	32.21	68.07	27.7
042	32.21	78.70	27.7
048	32.21	78.70	27.7
060	32.21	89.07	27.7
070	32.21	89.07	27.7

NOTES:
1. Locations are center-to-center of hanging bracket hole.
2. Dimensions are in inches.

TOP VIEW DRAWING
Right Return, Back or Left Discharge

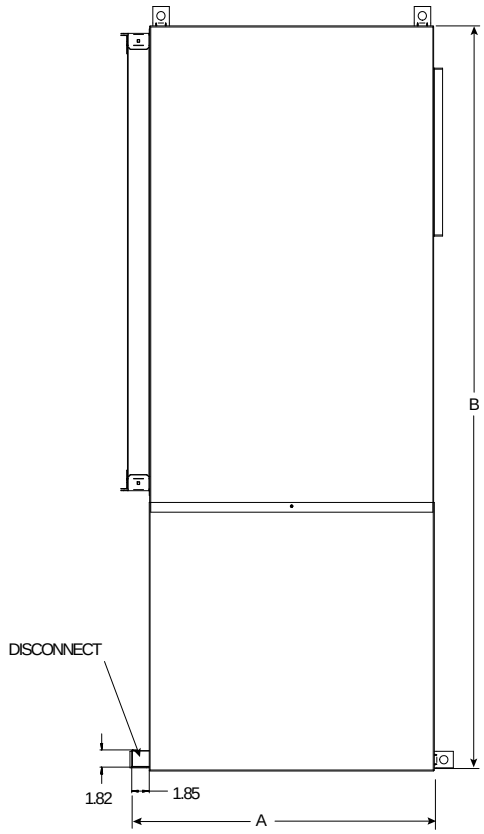


TOP VIEW DRAWING
Left Return, Back or Right Discharge



50PSH WITH FACTORY-INSTALLED DISCONNECT
LEFT RETURN

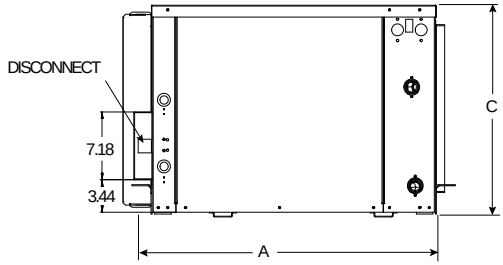
TOP VIEW



50PSH SIZE	WIDTH A	DEPTH B*	HEIGHT C
007	23.6	43.25	16.75
009	23.6	43.25	16.75
012	24.1	45.25	19.75
015	24.1	45.25	19.75
018	24.1	45.25	19.75
024	28.1	54.75	22.00Ž
030	32.1	68.25	22.00Ž
036	32.1	68.25	22.00Ž
042	32.1	79.00	22.00Ž
048	32.1	79.00	22.00Ž
060	32.1	89.25	22.00Ž
070	32.1	89.25	22.00Ž

*If WSHP Open Controller is factory-installed, increase depth by 2.6 inches.
Ž Total unit height is 22.75 with base rails for 024-070 units.
NOTE: Dimensions are shown in inches.

FRONT VIEW



Performance Summary For HP-CCH036C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH036C**	
Quantity:	**1**	
Part Number:	**50PSH036HWCCADEY**	
Unit Size:	**3 tons, 1200 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**9.**	gpm
Fluid Pressure Drop:	**4.6**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.66**	in wg
Filter Air Pressure Drop:	**.13**	in wg
Fan Speed:	**MED**	

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor Quantity:	**1**	
Compressor LRA:	**77.**	Amps
Compressor RLA:	**16.**	Amps
Fan FLA:	**6.**	Amps
Total FLA:	**22.**	Amps
Max fuse amps:	**40**	Amps
Min Circuit Amps:	**26**	Amps
Min/Max Voltage:	**187/253**	Volts
Fan Power:	**0.384**	kW

Cooling

Airflow:	**1,200.0**	CFM
Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp:	**80.6**	F
Cooling Ent. Air WB Temp:	**66.3**	F
Total Cooling:	**37.8**	MBH
Sensible Cooling:	**30.3**	MBH
Cooling EER:	**20.1**	Btuh/W
Cooling KW:	**1.49**	kW
Heat of Rejection:	**42.1**	MBH
Cooling LAT DB:	**57.0**	F
Cooling LAT WB:	**55.8**	F
Cooling LWT:	**79.4**	F
ARI/ISO 13256-1 WLHP Cooling:	**36.0**	MBH
ARI/ISO 13256-1 WLHP EER:	**17.2**	Btuh/W
ARI/ISO 13256-1 GWHP Cooling:	**40.2**	MBH
ARI/ISO 13256-1 GWHP EER:	**25.9**	Btuh/W
ARI/ISO 13256-1 GLHP Cooling:	**37.5**	MBH
ARI/ISO 13256-1 GLHP EER:	**19.7**	Btuh/W

Heating

Airflow:	**1,200.0**	CFM
Loop Temp Heating:	**70.0**	F
Heating Ent. Air DB Temp:	**68.0**	F
Heating LAT:	**104.2**	F
Total Heating:	**46.4**	MBH
Heating COP:	**5.8**	
Heating KW:	**2.34**	kW
Heat of Absorption:	**39.5**	MBH
Heating LWT:	**61.2**	F
ARI/ISO 13256-1 WLHP Heating:	**41.0**	MBH
ARI/ISO 13256-1 WLHP COP:	**5.6**	
ARI/ISO 13256-1 GWHP Heating:	**34.4**	MBH
ARI/ISO 13256-1 GWHP COP:	**4.9**	
ARI/ISO 13256-1 GLHP Heating:	**26.0**	MBH
ARI/ISO 13256-1 GLHP COP:	**4.1**	

Note

"WLHP" = Water Loop Heat Pump (Boiler/Tower)
"GWHP" = Ground Water Heat Pump (Open Loop)
"GLHP" = Ground Loop Heat Pump (Geothermal)

Acoustics Report For HP-CCH036C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH036C**
Quantity:	**1**
Unit Model:	**50PSH**
Unit Size:	**3 tons, 1200 CFM**
Compressor Type:	**PURON 1-Stage**
Configuration:	**Horizontal**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**MED**

Dimensions

Width:	**32.1**	in
Depth:	**70.9**	in
Height:	**22.8**	in
Shipping Weight:	**415.0**	lb

Octave Band Sound Power Level (dB re 1pW)
Standard Construction

Tested in accordance with ARI 260

Mode	Ducted Discharge Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		78	64	71	60	59	62	55	79	71
Heating Full		79	67	71	61	58	61	55	80	71
FAN Only		79	66	71	60	58	61	55	80	71

Mode	Free Inlet Combined w/Casing Radiated Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		65	62	62	63	58	52	43	70	66
Heating Full		67	63	63	64	59	52	44	71	67
FAN Only		65	62	62	63	58	52	43	70	66

Notes:

All performance is sound power level in dB referenced to 1 picoWatt.
Data based on sound measurements made in a reverberant room on representative units from each cabinet size in accordance with ARI standard 260-2000.

Detailed Performance Report For HP-CCH036C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH036C**	
Quantity:	**1**	
Part Number:	**50PSH036HWCCADEY**	
Unit Size:	**3 tons, 1200 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**9.**	gpm
Fluid Pressure Drop:	**4.6**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.50**	in wg
Filter Air Pressure Drop:	**.13**	in wg

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**77.**	Amps
Compressor RLA:	**16.**	Amps
Fan FLA:	**6.**	Amps
Total FLA:	**22.**	Amps
Max fuse amps:	**40**	Amps
Min Circuit Amps:	**26**	Amps
Min/Max Voltage:	**187/253**	Volts

Design Requirements

Cooling

Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp.:	**80.6**	F
Cooling Ent. Air WB Temp.:	**66.3**	F

Heating

Loop Temp Heating:	**70.0**	F
Heating Ent. air DB Temp.:	**68.0**	F

Fan Configuration

Fan Speed: **LOW**

Cooling

Airflow:	**1,090.0**	CFM
Total Cooling:	**37.2**	MBH
Sensible Cooling:	**28.8**	MBH
Cooling KW:	**1.5**	kW
EER:	**20.6**	Btuh/W
Leaving Air DB Temp.:	**55.8**	F
Leaving Air WB Temp.:	**54.8**	F
Cooling LWT:	**79.2**	F
Heat of Rejection:	**41.6**	MBH

Heating

Airflow:	**1,090.0**	CFM
Total Heating:	**45.8**	MBH
Heating KW:	**2.4**	kW
COP:	**5.6**	
Heating Leaving air Temp.:	**107.3**	F
Heating LWT:	**61.4**	F
Heat of Absorbtion:	**38.8**	MBH

Fan Configuration

Fan Speed: **MED**

Cooling

Airflow:	**1,245.0**	CFM
Total Cooling:	**38.1**	MBH
Sensible Cooling:	**31.0**	MBH
Cooling KW:	**1.5**	kW
EER:	**20.8**	Btuh/W
Leaving Air DB Temp.:	**57.3**	F
Leaving Air WB Temp.:	**56.2**	F
Cooling LWT:	**79.4**	F
Heat of Rejection:	**42.5**	MBH

Heating

Airflow:	**1,245.0**	CFM
Total Heating:	**46.4**	MBH
Heating KW:	**2.3**	kW
COP:	**6.0**	
Heating Leaving air Temp.:	**102.8**	F
Heating LWT:	**61.2**	F
Heat of Absorbtion:	**39.7**	MBH

Fan Configuration

Fan Speed: **HI**

Cooling

Airflow:	**1,345.0**	CFM
Total Cooling:	**38.5**	MBH
Sensible Cooling:	**32.4**	MBH
Cooling KW:	**1.5**	kW
EER:	**20.8**	Btuh/W
Leaving Air DB Temp.:	**58.1**	F
Leaving Air WB Temp.:	**56.9**	F
Cooling LWT:	**79.5**	F
Heat of Rejection:	**42.8**	MBH

Detailed Performance Report For HP-CCH036C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Heating

Airflow:	**1,345.0**	CFM	COP:	**6.1**	
Total Heating:	**46.6**	MBH	Heating Leaving air Temp.:	**100.4**	F
Heating KW:	**2.2**	kW	Heating LWT:	**61.1**	F
			Heat of Absorbtion:	**40.0**	MBH

HP-CCH042A

Tag Cover Sheet
Unit Report
Certified Drawing
Performance Report
Acoustic Summary
Detailed Performance Output Report

Unit Report For HP-CCH042A

Project: 15_smartWatt_WSHP
Prepared By: Brian W Meneghan

11/09/2015
12:04AM

Unit Parameters

Tag Name:	**HP-CCH042A**
Quantity:	**1**
Unit Model:	**50PSH**
Unit Size:	**3.5 tons, 1400 CFM**
Compressor Type:	**PURON 1-Stage**
Compressor Quantity:	**1**
Configuration:	**Horizontal**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**MED**

Dimensions

Width:	**32.1**	in
Depth:	**81.6**	in
Height:	**22.8**	in
Shipping Weight:	**465.0**	lb
Operating Weight:	**400.0**	lb
Packaging:	**Domestic**	

Filters

2-in MERV 8 Filter, 20 x 24 (qty 2)

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**79.**	Amps
Fan FLA:	**6.**	Amps
Min Circuit Amps:	**27**	Amps
Max fuse amps:	**40**	Amps

Corner Weights

Left Front:	**107**	lb
Right Front:	**99**	lb
Left Back:	**105**	lb
Right Back:	**89**	lb

Unit Options

Airflow:	**Left Return, Right Discharge, Constant Torque ECM**
Control Options:	**WSHP Open with C Microprocessor control**
Coil:	**Copper**
Operating Range/Sound Options:	**Standard Range (60 to 95 F) Closed Cell Foam**
Filters:	**Merv 8 Filter**
Valve Options:	**2-Way Solenoid Valve /w Measureflow**

Warranty Information

2nd-5th Year Parts & Labor on complete unit
Start-up Each Unit

First Year - Parts Only (Standard):	**No Cost**
Five year compressor – Parts only (standard):	**No Cost**

Notes:

ZS Sensor must be used with WSHP Open to monitor space temperature.

Ordering Information

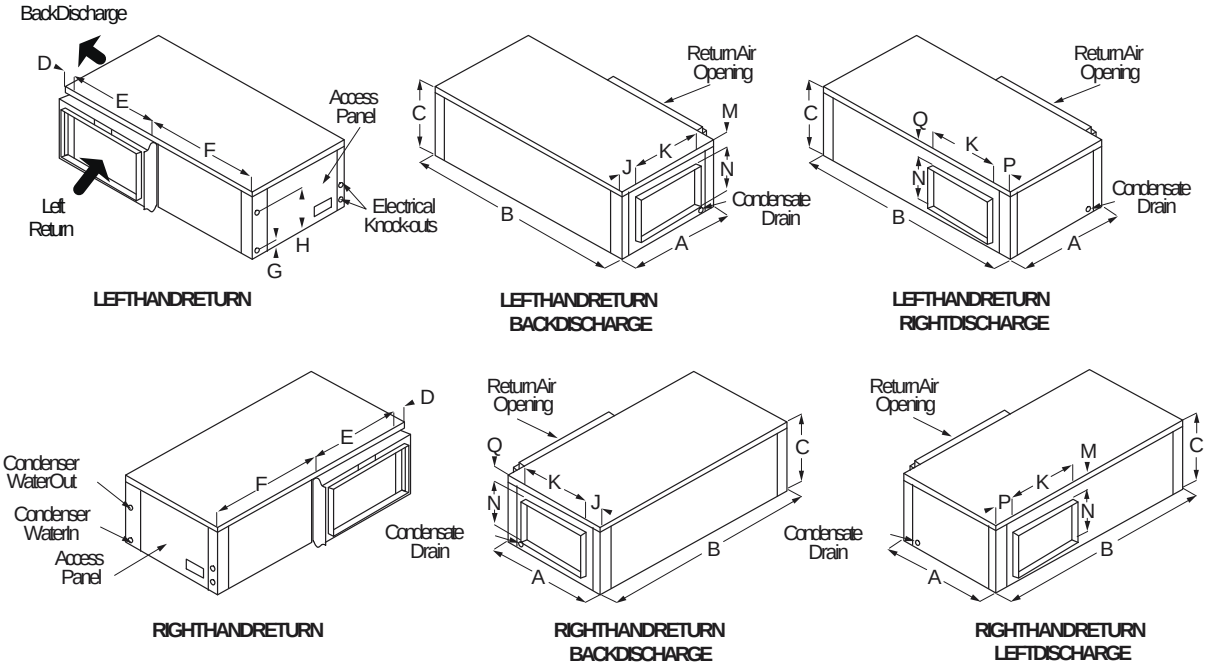
Part Number	Description	Quantity
Base Unit		
50PSH042HWCCADEY	Commercial Horizontal Puron Single-Stage Water Source Heat Pump 3.5 tons. 1400 CFM 208/230-1-60	1
Factory Options		
	Control Options: WSHP Open with C Microprocessor control	
	Operating Range/Sound Options: Standard Range (60 to 95 F) Closed Cell Foam	
	Valve Options: 2-Way Solenoid Valve /w Measureflow	
	Merv 8 Filter	
Accessories		
AHK1002	Stainless Steel Hose Kit, 1 in. diameter, 24 in. long	1
ZS-H-CAR	ZS Standard	1

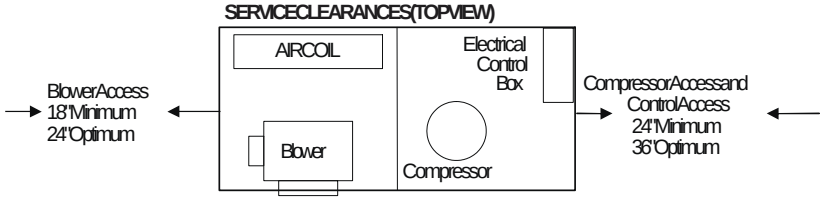
50PSH007-070UNITS

UNIT	A WIDTH	B DEPTH*	C HEIGHT	D CAB END TO FILTER RACK	E R/A DUCT WIDTH	F CAB FRONT TO FILTER RACK	G WATER IN	H WATER OUT	J SIDE TO DISC.	K DISC. WIDTH	M TOP TO DISC.	N DISC. HEIGHT	P END TO DISC.	Q TOP TO DISC.	FILTER RACK HEIGHT	R/A DUCT FLANGE HEIGHT	CONDENSER WATER CONNECTIONS	RECOMMENDED REPLACEMENT NOMINAL FILTER SIZE
007	21.75	43.25	16.75	0.50	20.25	22.25	2.25	13.87	3.50	11.75	4.62	7.75	3.50	4.62	15.00	13.00	3/4 FPT	15 x 20 x 1
009	21.75	43.25	16.75	0.50	20.25	22.25	2.25	13.87	3.50	11.75	4.62	7.75	3.50	4.62	15.00	13.00	3/4 FPT	15 x 20 x 1
012	22.25	45.25	19.75	0.62	20.25	24.25	2.50	12.50	3.62	11.75	7.12	7.75	3.62	4.75	18.00	16.00	3/4 FPT	18 x 20 x 1
015	22.25	45.25	19.75	1.62	20.25	23.25	2.50	12.50	2.75	13.75	3.12	13.75	2.75	2.87	18.00	16.00	3/4 FPT	18 x 20 x 1
018	22.25	45.25	19.75	1.62	20.25	23.25	2.50	12.50	2.75	13.75	3.12	13.75	2.75	2.87	18.00	16.00	3/4 FPT	18 x 20 x 1
024	26.25	54.75	22.00	1.25	30.25	23.00	2.62	15.12	3.75	13.75	2.12	15.75	3.75	4.25	20.12	18.00	3/4 FPT	20 x 30 x 1
030	30.25	68.25	22.00**	2.00	35.00	31.25	2.50	13.25	4.50	15.75	4.00	15.75	4.50	2.25	20.12	18.00	1 FPT	20 x 34.5 x 1
036	30.25	68.25	22.00**	2.00	35.00	31.25	2.50	13.25	4.50	15.75	4.00	15.75	4.50	2.25	20.12	18.00	1 FPT	20 x 34.5 x 1
042	30.25	79.00	22.00**	0.75	48.25	29.62	2.75	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 24 x 1 (2)
048	30.25	79.00	22.00**	0.75	48.25	29.62	2.75	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 24 x 1 (2)
060	30.25	89.25	22.00**	1.87	56.25	31.00	2.62	13.25	4.50	17.75	2.25	17.75	4.50	2.12	20.12	18.00	1 FPT	20 x 28 x 1 (2)
070	30.25	89.25	22.00**	1.87	56.25	31.00	5.75	17.75	4.87	17.75	2.62	17.75	4.87	1.75	20.12	18.00	1 FPT	20 x 28 x 1 (2)

*When WSHP Open controller is installed increase depth by 2.6 inches.
**Total unit height is 22.75 with base rails for 030-070 units.

NOTES:
1. All dimensions in inches unless otherwise noted. All dimensions within ± 0.125-in. Specifications subject to change without notice.
2. Unit sizes 015-070 discharge locations can be field converted between back discharge and side discharge.
3. Airflow configurations determined when facing panel with water connections.





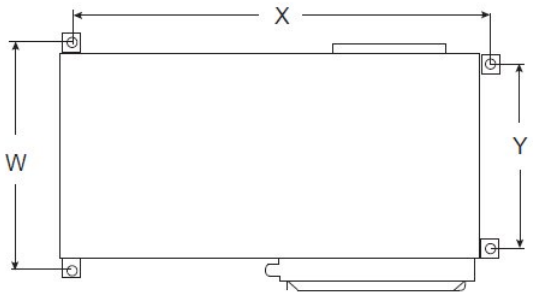
NOTE: The local electric codes may require 36-in. or more clearance at the electrical control box.

50PSH HANGING BRACKET

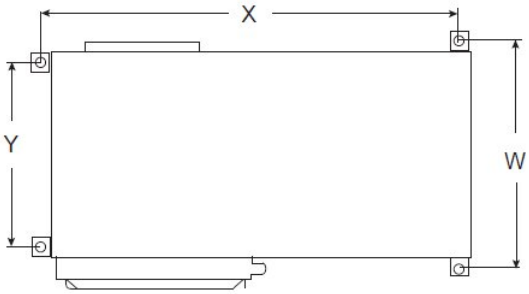
50PSH	W	X	Y
	FRONT	SIDE	BACK
007	23.85	43.08	19.3
009	23.85	43.08	19.3
012	24.35	45.07	19.8
015	24.35	45.07	19.8
018	24.35	45.07	19.8
024	28.35	54.57	23.8
030	32.21	68.07	27.7
036	32.21	68.07	27.7
042	32.21	78.70	27.7
048	32.21	78.70	27.7
060	32.21	89.07	27.7
070	32.21	89.07	27.7

NOTES:
1. Locations are center-to-center of hanging bracket hole.
2. Dimensions are in inches.

TOP VIEW DRAWING
Right Return, Back or Left Discharge

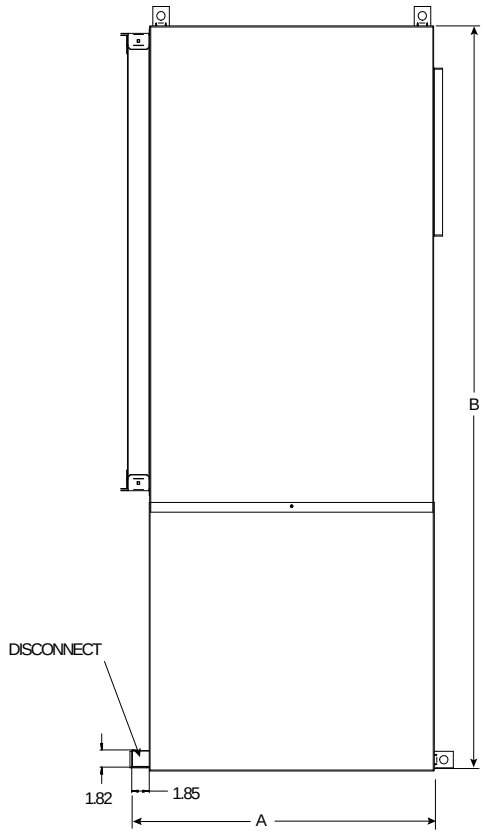


TOP VIEW DRAWING
Left Return, Back or Right Discharge



50PSH WITH FACTORY-INSTALLED DISCONNECT
LEFT RETURN

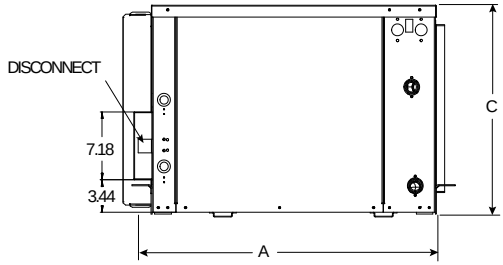
TOP VIEW



50PSH SIZE	WIDTH A	DEPTH B*	HEIGHT C
007	23.6	43.25	16.75
009	23.6	43.25	16.75
012	24.1	45.25	19.75
015	24.1	45.25	19.75
018	24.1	45.25	19.75
024	28.1	54.75	22.00Ž
030	32.1	68.25	22.00Ž
036	32.1	68.25	22.00Ž
042	32.1	79.00	22.00Ž
048	32.1	79.00	22.00Ž
060	32.1	89.25	22.00Ž
070	32.1	89.25	22.00Ž

*If WSHP Open Controller is factory-installed, increase depth by 2.6 inches.
Ž Total unit height is 22.75 with base rails for 024-070 units.
NOTE: Dimensions are shown in inches.

FRONT VIEW



Performance Summary For HP-CCH042A

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH042A**	
Quantity:	**1**	
Part Number:	**50PSH042HWCCADEY**	
Unit Size:	**3.5 tons, 1400 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**10.5**	gpm
Fluid Pressure Drop:	**6.1**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.30**	in wg
Filter Air Pressure Drop:	**.10**	in wg
Fan Speed:	**MED**	

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor Quantity:	**1**	
Compressor LRA:	**79.**	Amps
Compressor RLA:	**16.7**	Amps
Fan FLA:	**6.**	Amps
Total FLA:	**22.7**	Amps
Max fuse amps:	**40**	Amps
Min Circuit Amps:	**27**	Amps
Min/Max Voltage:	**187/253**	Volts
Fan Power:	**0.261**	kW

Cooling

Airflow:	**1,400.0**	CFM
Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp:	**80.6**	F
Cooling Ent. Air WB Temp:	**66.3**	F
Total Cooling:	**44.8**	MBH
Sensible Cooling:	**35.8**	MBH
Cooling EER:	**23.8**	Btuh/W
Cooling KW:	**1.62**	kW
Heat of Rejection:	**49.5**	MBH
Cooling LAT DB:	**56.6**	F
Cooling LAT WB:	**55.7**	F
Cooling LWT:	**79.4**	F
ARI/ISO 13256-1 WLHP Cooling:	**40.6**	MBH
ARI/ISO 13256-1 WLHP EER:	**18.2**	Btuh/W
ARI/ISO 13256-1 GWHP Cooling:	**45.0**	MBH
ARI/ISO 13256-1 GWHP EER:	**25.7**	Btuh/W
ARI/ISO 13256-1 GLHP Cooling:	**42.2**	MBH
ARI/ISO 13256-1 GLHP EER:	**21.7**	Btuh/W

Heating

Airflow:	**1,400.0**	CFM
Loop Temp Heating:	**70.0**	F
Heating Ent. Air DB Temp:	**68.0**	F
Heating LAT:	**99.9**	F
Total Heating:	**47.8**	MBH
Heating COP:	**6.0**	
Heating KW:	**2.32**	kW
Heat of Absorption:	**41.0**	MBH
Heating LWT:	**62.2**	F
ARI/ISO 13256-1 WLHP Heating:	**42.4**	MBH
ARI/ISO 13256-1 WLHP COP:	**6.0**	
ARI/ISO 13256-1 GWHP Heating:	**35.0**	MBH
ARI/ISO 13256-1 GWHP COP:	**5.1**	
ARI/ISO 13256-1 GLHP Heating:	**26.8**	MBH
ARI/ISO 13256-1 GLHP COP:	**4.1**	

Note

"WLHP" = Water Loop Heat Pump (Boiler/Tower)
"GWHP" = Ground Water Heat Pump (Open Loop)
"GLHP" = Ground Loop Heat Pump (Geothermal)

Acoustics Report For HP-CCH042A

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH042A**
Quantity:	**1**
Unit Model:	**50PSH**
Unit Size:	**3.5 tons, 1400 CFM**
Compressor Type:	**PURON 1-Stage**
Configuration:	**Horizontal**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**MED**

Dimensions

Width:	**32.1**	in
Depth:	**81.6**	in
Height:	**22.8**	in
Shipping Weight:	**465.0**	lb

Octave Band Sound Power Level (dB re 1pW)
Standard Construction

Tested in accordance with ARI 260

Mode	Ducted Discharge Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		73	58	66	57	56	56	50	74	66
Heating Full		75	59	66	56	56	56	49	76	66
FAN Only		73	59	66	57	56	56	49	74	66

Mode	Free Inlet Combined w/Casing Radiated Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		71	58	57	55	46	46	39	71	60
Heating Full		73	58	57	55	47	47	39	73	61
FAN Only		56	55	57	55	46	46	37	62	59

Notes:

All performance is sound power level in dB referenced to 1 picoWatt.
Data based on sound measurements made in a reverberant room on representative units from each cabinet size in accordance with ARI standard 260-2000.

Detailed Performance Report For HP-CCH042A

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-CCH042A**	
Quantity:	**1**	
Part Number:	**50PSH042HWCCADEY**	
Unit Size:	**3.5 tons, 1400 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**10.5**	gpm
Fluid Pressure Drop:	**6.1**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.50**	in wg
Filter Air Pressure Drop:	**.10**	in wg

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**79.**	Amps
Compressor RLA:	**16.7**	Amps
Fan FLA:	**6.**	Amps
Total FLA:	**22.7**	Amps
Max fuse amps:	**40**	Amps
Min Circuit Amps:	**27**	Amps
Min/Max Voltage:	**187/253**	Volts

Design Requirements

Cooling

Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp.:	**80.6**	F
Cooling Ent. Air WB Temp.:	**66.3**	F

Heating

Loop Temp Heating:	**70.0**	F
Heating Ent. air DB Temp.:	**68.0**	F

Fan Configuration

Fan Speed: **LOW**

Cooling

Airflow:	**1,100.0**	CFM
Total Cooling:	**42.4**	MBH
Sensible Cooling:	**31.2**	MBH
Cooling KW:	**1.6**	kW
EER:	**22.2**	Btuh/W
Leaving Air DB Temp.:	**54.0**	F
Leaving Air WB Temp.:	**53.2**	F
Cooling LWT:	**79.0**	F
Heat of Rejection:	**47.1**	MBH

Heating

Airflow:	**1,100.0**	CFM
Total Heating:	**46.8**	MBH
Heating KW:	**2.6**	kW
COP:	**5.3**	
Heating Leaving air Temp.:	**107.8**	F
Heating LWT:	**62.5**	F
Heat of Absorbtion:	**39.2**	MBH

Fan Configuration

Fan Speed: **MED**

Cooling

Airflow:	**1,345.0**	CFM
Total Cooling:	**44.1**	MBH
Sensible Cooling:	**34.8**	MBH
Cooling KW:	**1.6**	kW
EER:	**22.7**	Btuh/W
Leaving Air DB Temp.:	**56.4**	F
Leaving Air WB Temp.:	**55.4**	F
Cooling LWT:	**79.3**	F
Heat of Rejection:	**48.9**	MBH

Heating

Airflow:	**1,345.0**	CFM
Total Heating:	**47.8**	MBH
Heating KW:	**2.4**	kW
COP:	**5.8**	
Heating Leaving air Temp.:	**101.2**	F
Heating LWT:	**62.3**	F
Heat of Absorbtion:	**40.7**	MBH

Fan Configuration

Fan Speed: **HI**

Cooling

Airflow:	**1,560.0**	CFM
Total Cooling:	**45.2**	MBH
Sensible Cooling:	**37.8**	MBH
Cooling KW:	**1.6**	kW
EER:	**22.8**	Btuh/W
Leaving Air DB Temp.:	**57.9**	F
Leaving Air WB Temp.:	**56.8**	F
Cooling LWT:	**79.5**	F
Heat of Rejection:	**49.9**	MBH

Detailed Performance Report For HP-CCH042A

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Heating

Airflow:	**1,560.0**	CFM	COP:	**6.0**	
Total Heating:	**48.4**	MBH	Heating Leaving air Temp.:	**97.0**	F
Heating KW:	**2.3**	kW	Heating LWT:	**62.1**	F
			Heat of Absorbtion:	**41.5**	MBH

HP-FCV009

Tag Cover Sheet
Unit Report
Certified Drawing
Performance Report
Acoustic Summary
Detailed Performance Output Report

Unit Report For HP-FCV009

Project: 15_smartWatt_WSHP
Prepared By: Brian W Meneghan

11/09/2015
12:04AM

Unit Parameters

Tag Name:	**HP-FCV009**
Quantity:	**1**
Unit Model:	**50PSV**
Unit Size:	**0.5 tons, 300 CFM**
Compressor Type:	**PURON 1-Stage**
Compressor Quantity:	**1**
Configuration:	**Vertical**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**LOW**

Dimensions

Width:	**23.7**	in
Depth:	**24.4**	in
Height:	**32.8**	in
Shipping Weight:	**160.0**	lb
Operating Weight:	**140.0**	lb
Packaging:	**Domestic**	

Filters

2-in MERV 8 Filter, 15 x 20 (qty 1)

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**17.7**	Amps
Fan FLA:	**.96**	Amps
Min Circuit Amps:	**4**	Amps
Max fuse amps:	**15**	Amps

Unit Options

Airflow:	**Right Return, Top Discharge, PSC**
Control Options:	**WSHP Open with C Microprocessor control**
Coil:	**Copper**
Operating Range/Sound Options:	**Extended Range (20 to 110 F) Closed Cell Foam**
Filters:	**Merv 8 Filter**
Valve Options:	**2-Way Solenoid Valve /w Measureflow**

Warranty Information

Start-up Each Unit
2nd-5th Year Parts & Labor on complete unit

First Year - Parts Only (Standard):	**No Cost**
Five year compressor – Parts only (standard):	**No Cost**

Notes:

ZS Sensor must be used with WSHP Open to monitor space temperature.

Ordering Information

Part Number	Description	Quantity
Base Unit		
50PSV007RWCCADDY	Commercial Vertical Puron Single-Stage Water Source Heat Pump 0.5 tons. 300 CFM 208/230-1-60	1
Factory Options		
	Control Options: WSHP Open with C Microprocessor control	

	Operating Range/Sound Options: Extended Range (20 to 110 F) Closed Cell Foam	
	Valve Options: 2-Way Solenoid Valve /w Measureflow	
	Merv 8 Filter	
Accessories		
AHK0752	Stainless Steel Hose Kit, 3/4 in. diameter, 24 in. long	1
ZS-H-CAR	ZS Standard	1

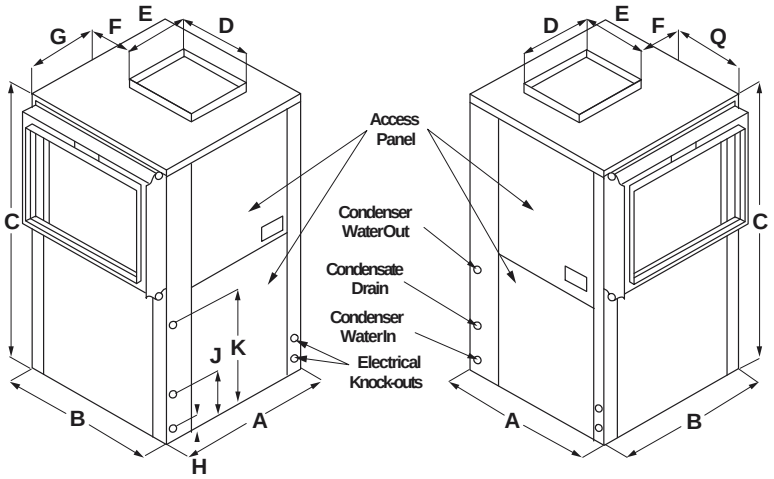
50PSV007-070UNITS

UNIT	A WIDTH	B DEPTH*	C HEIGHT	D DISCHARGE DEPTH	E DISCHARGE WIDTH	F CABINET EDGE TO DISCHARGE	G LEFT SIDE TO DISC.	H WATER IN	J BOTTOM TO COND. DRAIN	K WATER OUT	M R/A DUCT WIDTH	N R/A DUCT FLANGE HEIGHT	P FILTER RACK HEIGHT	Q RIGHT SIDE TO DISC.	CONDENSER WATER CONN.	RECOMMENDED REPLACEMENT NOMINAL FILTER SIZE
007	21.75	21.75	32.75	11.75	7.75	5.00	8.50	2.25	8.00	13.75	18.00	13.00	15.00	8.50	3/4 FPT	15 x 20 x 1
009	21.75	21.75	32.75	11.75	7.75	5.00	8.50	2.25	8.00	13.75	18.00	13.00	15.00	8.50	3/4 FPT	15 x 20 x 1
012	21.75	21.75	32.75	11.75	7.75	5.00	8.50	2.62	7.50	12.50	18.00	16.00	18.00	8.50	3/4 FPT	18 x 20 x 1
015	21.75	21.75	39.25	13.75	13.75	4.00	6.12	2.25	7.50	12.25	18.00	18.00	20.00	4.00	3/4 FPT	20 x 20 x 1
018	21.75	21.75	39.25	13.75	13.75	4.00	6.12	2.25	7.50	12.25	18.00	18.00	20.00	4.00	3/4 FPT	20 x 20 x 1
024	21.75	26.25	47.25	13.75	15.75	6.25	4.87	2.50	8.75	15.00	22.00	22.00	24.00	4.00	3/4 FPT	24 x 24 x 1
030	24.25	33.50	47.25	15.75	15.75	8.87	7.00	2.50	8.50	14.50	28.00	22.00	24.00	4.00	1 FPT	24 x 30 x 1
036	24.25	33.50	47.25	15.75	15.75	8.87	7.00	2.50	8.50	14.50	28.00	22.00	24.00	4.00	1 FPT	24 x 30 x 1
042	26.25	33.50	58.25	17.75	17.75	7.87	6.75	3.25	8.50	13.25	28.00	30.00	32.00	4.00	1 FPT	16 x 30 x 1 (2)
048	26.25	33.50	58.25	17.75	17.75	7.87	6.75	3.25	8.50	13.25	28.00	30.00	32.00	4.00	1 FPT	16 x 30 x 1 (2)
060	26.25	33.50	66.25	17.75	17.75	7.87	7.00	3.25	8.50	13.25	28.00	38.00	40.00	4.00	1 FPT	20 x 30 x 1 (2)
070	26.25	33.50	66.25	17.75	17.75	7.87	7.25	4.25	10.00	17.00	28.00	38.00	40.00	3.00	1 FPT	20 x 30 x 1 (2)

* When WSHP Open controller is installed increase depth by 2.6 inches.

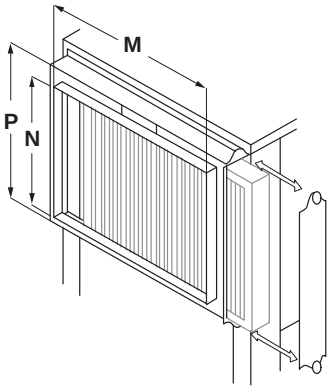
NOTES:

1. All dimensions in inches unless otherwise noted. All dimensions within ± 0.125-in. Specifications subject to change without notice.
2. Airflow configuration determined when facing panel with water connections.



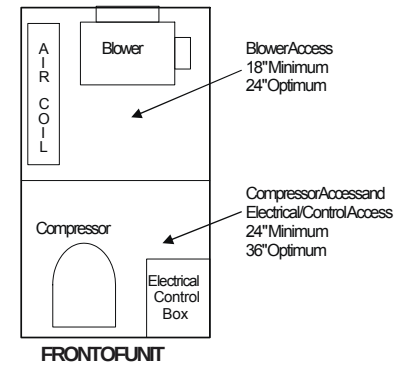
LEFT HAND RETURN

RIGHT HAND RETURN



RETURN AIR (FILTER) VIEW

SERVICE CLEARANCES



FRONT OF UNIT

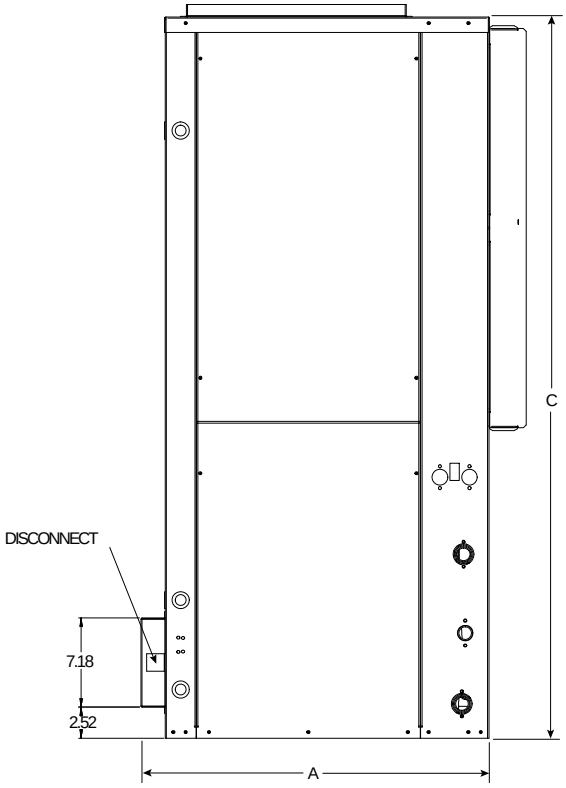
NOTE: The local electric codes may require 36-in. or more clearance at the electrical control box.

50PSV WITH FACTORY-INSTALLED DISCONNECT
RIGHT RETURN

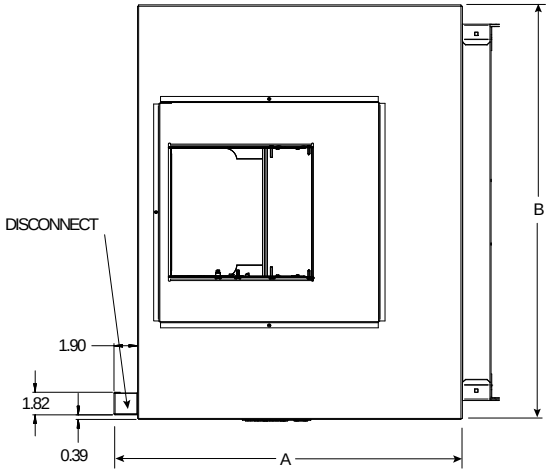
50PSV SIZE	WIDTH A	DEPTH B*	HEIGHT C
007	23.65	21.75	32.75
009	23.65	21.75	32.75
012	23.65	21.75	32.75
015	23.65	21.75	39.25
018	23.65	21.75	39.25
024	23.65	26.25	47.25
030	26.15	33.50	47.25
036	26.15	33.50	47.25
042	28.15	33.50	58.25
048	28.15	33.50	58.25
060	28.15	33.50	66.25
070	28.15	33.50	66.25

*If WSHP Open Controller is factory-installed, increase depth by 2.6 inches.
NOTE: Dimensions are shown in inches.

FRONT VIEW



TOP VIEW



Performance Summary For HP-FCV009

Project: 15_smartWatt_WSHP
Prepared By: Brian W Meneghan

11/09/2015
12:04AM

Unit Parameters

Tag Name:	**HP-FCV009**	
Quantity:	**1**	
Part Number:	**50PSV007RWCCADDY**	
Unit Size:	**0.5 tons, 300 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**1.5**	gpm
Fluid Pressure Drop:	**2.9**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.45**	in wg
Filter Air Pressure Drop:	**.09**	in wg
Fan Speed:	**LOW**	

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor Quantity:	**1**	
Compressor LRA:	**17.7**	Amps
Compressor RLA:	**2.5**	Amps
Fan FLA:	**.96**	Amps
Total FLA:	**3.46**	Amps
Max fuse amps:	**15**	Amps
Min Circuit Amps:	**4**	Amps
Min/Max Voltage:	**187/253**	Volts
Fan Power:	**0.114**	kW

Cooling

Airflow:	**300.0**	CFM
Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp:	**80.6**	F
Cooling Ent. Air WB Temp:	**66.2**	F
Total Cooling:	**7.4**	MBH
Sensible Cooling:	**6.7**	MBH
Cooling EER:	**17.1**	Btuh/W
Cooling KW:	**.32**	kW
Heat of Rejection:	**8.4**	MBH
Cooling LAT DB:	**59.8**	F
Cooling LAT WB:	**58.1**	F
Cooling LWT:	**81.2**	F
ARI/ISO 13256-1 WLHP Cooling:	**6.8**	MBH
ARI/ISO 13256-1 WLHP EER:	**15.7**	Btuh/W
ARI/ISO 13256-1 GWHP Cooling:	**8.4**	MBH
ARI/ISO 13256-1 GWHP EER:	**25.1**	Btuh/W
ARI/ISO 13256-1 GLHP Cooling:	**7.4**	MBH
ARI/ISO 13256-1 GLHP EER:	**18.5**	Btuh/W

Heating

Airflow:	**300.0**	CFM
Loop Temp Heating:	**70.0**	F
Heating Ent. Air DB Temp:	**68.0**	F
Heating LAT:	**94.9**	F
Total Heating:	**8.6**	MBH
Heating COP:	**5.1**	
Heating KW:	**.50**	kW
Heat of Absorption:	**7.2**	MBH
Heating LWT:	**60.4**	F
ARI/ISO 13256-1 WLHP Heating:	**8.8**	MBH
ARI/ISO 13256-1 WLHP COP:	**5.7**	
ARI/ISO 13256-1 GWHP Heating:	**7.0**	MBH
ARI/ISO 13256-1 GWHP COP:	**4.9**	
ARI/ISO 13256-1 GLHP Heating:	**5.1**	MBH
ARI/ISO 13256-1 GLHP COP:	**3.6**	

Note

"WLHP" = Water Loop Heat Pump (Boiler/Tower)
"GWHP" = Ground Water Heat Pump (Open Loop)
"GLHP" = Ground Loop Heat Pump (Geothermal)

Acoustics Report For HP-FCV009

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-FCV009**
Quantity:	**1**
Unit Model:	**50PSV**
Unit Size:	**0.5 tons, 300 CFM**
Compressor Type:	**PURON 1-Stage**
Configuration:	**Vertical**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**LOW**

Dimensions

Width:	**23.7**	in
Depth:	**24.4**	in
Height:	**32.8**	in
Shipping Weight:	**160.0**	lb

Octave Band Sound Power Level (dB re 1pW)
Standard Construction

Tested in accordance with ARI 260

Mode	Ducted Discharge Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		60	47	51	57	51	45	37	63	59
Heating Full		61	50	51	53	47	46	39	63	56
FAN Only		58	50	51	56	47	46	39	61	58

Mode	Free Inlet Combined w/Casing Radiated Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		64	48	43	42	38	32	27	64	
Heating Full		63	58	44	44	40	34	28	64	
FAN Only		54	43	42	42	37	31	24	55	46

Notes:

All performance is sound power level in dB referenced to 1 picoWatt.
Data based on sound measurements made in a reverberant room on representative units from each cabinet size in accordance with ARI standard 260-2000.

Detailed Performance Report For HP-FCV009

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-FCV009**	
Quantity:	**1**	
Part Number:	**50PSV007RWCCADDY**	
Unit Size:	**0.5 tons, 300 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**1.5**	gpm
Fluid Pressure Drop:	**2.9**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.50**	in wg
Filter Air Pressure Drop:	**.09**	in wg

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**17.7**	Amps
Compressor RLA:	**2.5**	Amps
Fan FLA:	**.96**	Amps
Total FLA:	**3.46**	Amps
Max fuse amps:	**15**	Amps
Min Circuit Amps:	**4**	Amps
Min/Max Voltage:	**187/253**	Volts

Design Requirements

Cooling

Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp.:	**80.6**	F
Cooling Ent. Air WB Temp.:	**66.2**	F

Heating

Loop Temp Heating:	**70.0**	F
Heating Ent. air DB Temp.:	**68.0**	F

Fan Configuration

Fan Speed: **LOW**

Cooling

Airflow:	**285.0**	CFM
Total Cooling:	**7.4**	MBH
Sensible Cooling:	**6.5**	MBH
Cooling KW:	**.3**	kW
EER:	**16.8**	Btuh/W
Leaving Air DB Temp.:	**59.4**	F
Leaving Air WB Temp.:	**57.8**	F
Cooling LWT:	**81.1**	F
Heat of Rejection:	**8.3**	MBH

Heating

Airflow:	**285.0**	CFM
Total Heating:	**8.6**	MBH
Heating KW:	**.5**	kW
COP:	**5.0**	
Heating Leaving air Temp.:	**96.3**	F
Heating LWT:	**60.5**	F
Heat of Absorbtion:	**7.1**	MBH

Fan Configuration

Fan Speed: **HI**

Cooling

Airflow:	**335.0**	CFM
Total Cooling:	**7.5**	MBH
Sensible Cooling:	**7.0**	MBH
Cooling KW:	**.3**	kW
EER:	**16.9**	Btuh/W
Leaving Air DB Temp.:	**61.0**	F
Leaving Air WB Temp.:	**59.0**	F
Cooling LWT:	**81.3**	F
Heat of Rejection:	**8.5**	MBH

Heating

Airflow:	**335.0**	CFM
Total Heating:	**8.7**	MBH
Heating KW:	**.5**	kW
COP:	**5.1**	
Heating Leaving air Temp.:	**92.4**	F
Heating LWT:	**60.3**	F
Heat of Absorbtion:	**7.3**	MBH

Fan Configuration

Fan Speed: **MED**

Cooling

Airflow:	**310.0**	CFM
Total Cooling:	**7.5**	MBH
Sensible Cooling:	**6.8**	MBH
Cooling KW:	**.3**	kW
EER:	**16.9**	Btuh/W

Leaving Air DB Temp.:	**60.1**	F
Leaving Air WB Temp.:	**58.4**	F
Cooling LWT:	**81.2**	F
Heat of Rejection:	**8.4**	MBH

Detailed Performance Report For HP-FCV009

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Heating

Airflow:	**310.0**	CFM	COP:	**5.1**	
Total Heating:	**8.7**	MBH	Heating Leaving air Temp.:	**94.2**	F
Heating KW:	**.5**	kW	Heating LWT:	**60.4**	F
			Heat of Absorbtion:	**7.2**	MBH

HP-FCV060

Tag Cover Sheet
Unit Report
Certified Drawing
Performance Report
Acoustic Summary
Detailed Performance Output Report

Unit Report For HP-FCV060

Project: 15_smartWatt_WSHP
Prepared By: Brian W Meneghan

11/09/2015
12:04AM

Unit Parameters

Tag Name:	**HP-FCV060**
Quantity:	**1**
Unit Model:	**50PSV**
Unit Size:	**5 tons, 2000 CFM**
Compressor Type:	**PURON 1-Stage**
Compressor Quantity:	**1**
Configuration:	**Vertical**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**LOW**

Dimensions

Width:	**26.3**	in
Depth:	**36.1**	in
Height:	**66.3**	in
Shipping Weight:	**422.0**	lb
Operating Weight:	**396.0**	lb
Packaging:	**Domestic**	

Filters

2-in MERV 8 Filter, 20 x 30 (qty 2)

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**134.**	Amps
Fan FLA:	**7.6**	Amps
Min Circuit Amps:	**39**	Amps
Max fuse amps:	**60**	Amps

Unit Options

Airflow:	**Right Return, Top Discharge, Constant Torque ECM**
Control Options:	**WSHP Open with C Microprocessor control**
Coil:	**Copper**
Operating Range/Sound Options:	**Standard Range (60 to 95 F) Closed Cell Foam**
Filters:	**Merv 8 Filter**
Valve Options:	**2-Way Solenoid Valve /w Measureflow**

Warranty Information

Start-up Each Unit
2nd-5th Year Parts & Labor on complete unit

First Year - Parts Only (Standard):	**No Cost**
Five year compressor – Parts only (standard):	**No Cost**

Notes:

ZS Sensor must be used with WSHP Open to monitor space temperature.

Ordering Information

Part Number	Description	Quantity
Base Unit		
50PSV060DWC3ADEY	Commercial Vertical Puron Single-Stage Water Source Heat Pump 5 tons. 2000 CFM 208/230-1-60	1
Factory Options		
	Control Options: WSHP Open with C Microprocessor control	

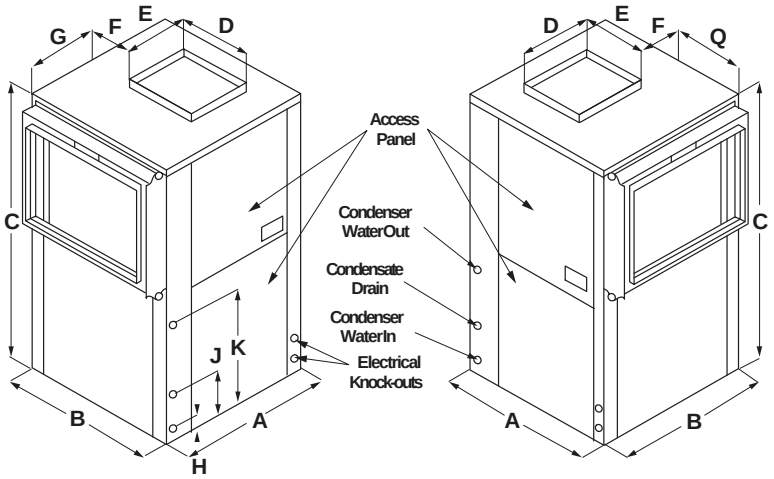
	Operating Range/Sound Options: Standard Range (60 to 95 F) Closed Cell Foam	
	Valve Options: 2-Way Solenoid Valve /w Measureflow	
	Merv 8 Filter	
Accessories		
AHK1002	Stainless Steel Hose Kit, 1 in. diameter, 24 in. long	1
ZS-H-CAR	ZS Standard	1

50PSV007-070UNITS

UNIT	A WIDTH	B DEPTH*	C HEIGHT	D DISCHARGE DEPTH	E DISCHARGE WIDTH	F CABINET EDGE TO DISCHARGE	G LEFT SIDE TO DISC.	H WATER IN	J BOTTOM TO COND. DRAIN	K WATER OUT	M R/A DUCT WIDTH	N R/A DUCT FLANGE HEIGHT	P FILTER RACK HEIGHT	Q RIGHT SIDE TO DISC.	CONDENSER WATER CONN.	RECOMMENDED REPLACEMENT NOMINAL FILTER SIZE
007	21.75	21.75	32.75	11.75	7.75	5.00	8.50	2.25	8.00	13.75	18.00	13.00	15.00	8.50	3/4 FPT	15 x 20 x 1
009	21.75	21.75	32.75	11.75	7.75	5.00	8.50	2.25	8.00	13.75	18.00	13.00	15.00	8.50	3/4 FPT	15 x 20 x 1
012	21.75	21.75	32.75	11.75	7.75	5.00	8.50	2.62	7.50	12.50	18.00	16.00	18.00	8.50	3/4 FPT	18 x 20 x 1
015	21.75	21.75	39.25	13.75	13.75	4.00	6.12	2.25	7.50	12.25	18.00	18.00	20.00	4.00	3/4 FPT	20 x 20 x 1
018	21.75	21.75	39.25	13.75	13.75	4.00	6.12	2.25	7.50	12.25	18.00	18.00	20.00	4.00	3/4 FPT	20 x 20 x 1
024	21.75	26.25	47.25	13.75	15.75	6.25	4.87	2.50	8.75	15.00	22.00	22.00	24.00	4.00	3/4 FPT	24 x 24 x 1
030	24.25	33.50	47.25	15.75	15.75	8.87	7.00	2.50	8.50	14.50	28.00	22.00	24.00	4.00	1 FPT	24 x 30 x 1
036	24.25	33.50	47.25	15.75	15.75	8.87	7.00	2.50	8.50	14.50	28.00	22.00	24.00	4.00	1 FPT	24 x 30 x 1
042	26.25	33.50	58.25	17.75	17.75	7.87	6.75	3.25	8.50	13.25	28.00	30.00	32.00	4.00	1 FPT	16 x 30 x 1 (2)
048	26.25	33.50	58.25	17.75	17.75	7.87	6.75	3.25	8.50	13.25	28.00	30.00	32.00	4.00	1 FPT	16 x 30 x 1 (2)
060	26.25	33.50	66.25	17.75	17.75	7.87	7.00	3.25	8.50	13.25	28.00	38.00	40.00	4.00	1 FPT	20 x 30 x 1 (2)
070	26.25	33.50	66.25	17.75	17.75	7.87	7.25	4.25	10.00	17.00	28.00	38.00	40.00	3.00	1 FPT	20 x 30 x 1 (2)

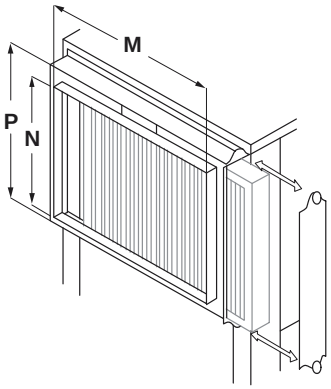
* When WSHP Open controller is installed increase depth by 2.6 inches.

NOTES:
1. All dimensions in inches unless otherwise noted. All dimensions within ± 0.125-in. Specifications subject to change without notice.
2. Airflow configuration determined when facing panel with water connections.



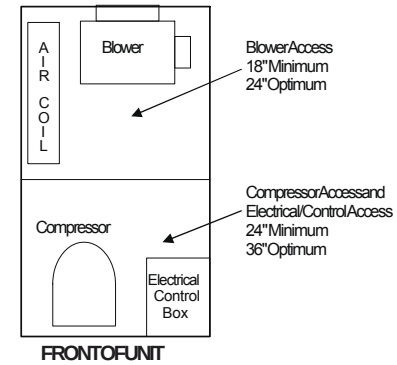
LEFT HAND RETURN

RIGHT HAND RETURN



RETURN AIR (FILTER) VIEW

SERVICE CLEARANCES



FRONT OF UNIT

NOTE: The local electric codes may require 36-in. or more clearance at the electrical control box.

Performance Summary For HP-FCV060

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-FCV060**	
Quantity:	**1**	
Part Number:	**50PSV060DWC3ADEY**	
Unit Size:	**5 tons, 2000 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**15.**	gpm
Fluid Pressure Drop:	**11.7**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.50**	in wg
Filter Air Pressure Drop:	**.09**	in wg
Fan Speed:	**LOW**	

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor Quantity:	**1**	
Compressor LRA:	**134.**	Amps
Compressor RLA:	**25.**	Amps
Fan FLA:	**7.6**	Amps
Total FLA:	**32.6**	Amps
Max fuse amps:	**60**	Amps
Min Circuit Amps:	**39**	Amps
Min/Max Voltage:	**187/253**	Volts
Fan Power:	**0.565**	kW

Cooling

Airflow:	**1,695.0**	CFM
Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp:	**80.6**	F
Cooling Ent. Air WB Temp:	**66.2**	F
Total Cooling:	**64.0**	MBH
Sensible Cooling:	**47.4**	MBH
Cooling EER:	**19.1**	Btuh/W
Cooling KW:	**2.79**	kW
Heat of Rejection:	**72.2**	MBH
Cooling LAT DB:	**54.4**	F
Cooling LAT WB:	**53.4**	F
Cooling LWT:	**79.6**	F
ARI/ISO 13256-1 WLHP Cooling:	**60.4**	MBH
ARI/ISO 13256-1 WLHP EER:	**16.2**	Btuh/W
ARI/ISO 13256-1 GWHP Cooling:	**66.5**	MBH
ARI/ISO 13256-1 GWHP EER:	**24.1**	Btuh/W
ARI/ISO 13256-1 GLHP Cooling:	**61.5**	MBH
ARI/ISO 13256-1 GLHP EER:	**18.5**	Btuh/W

Heating

Airflow:	**1,695.0**	CFM
Loop Temp Heating:	**70.0**	F
Heating Ent. Air DB Temp:	**68.0**	F
Heating LAT:	**111.7**	F
Total Heating:	**79.2**	MBH
Heating COP:	**5.5**	
Heating KW:	**4.26**	kW
Heat of Absorption:	**66.7**	MBH
Heating LWT:	**61.1**	F
ARI/ISO 13256-1 WLHP Heating:	**71.5**	MBH
ARI/ISO 13256-1 WLHP COP:	**5.7**	
ARI/ISO 13256-1 GWHP Heating:	**56.7**	MBH
ARI/ISO 13256-1 GWHP COP:	**4.9**	
ARI/ISO 13256-1 GLHP Heating:	**47.0**	MBH
ARI/ISO 13256-1 GLHP COP:	**4.2**	

Note

"WLHP" = Water Loop Heat Pump (Boiler/Tower)
"GWHP" = Ground Water Heat Pump (Open Loop)
"GLHP" = Ground Loop Heat Pump (Geothermal)

Acoustics Report For HP-FCV060

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-FCV060**
Quantity:	**1**
Unit Model:	**50PSV**
Unit Size:	**5 tons, 2000 CFM**
Compressor Type:	**PURON 1-Stage**
Configuration:	**Vertical**
Capacity/Efficiency:	**High Efficiency**
Fan Speed:	**LOW**

Dimensions

Width:	**26.3**	in
Depth:	**36.1**	in
Height:	**66.3**	in
Shipping Weight:	**422.0**	lb

Octave Band Sound Power Level (dB re 1pW)
Standard Construction

Tested in accordance with ARI 260

Mode	Ducted Discharge Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		78	65	66	60	57	60	54	79	69
Heating Full		76	64	67	60	54	59	52	77	68
FAN Only		77	65	66	60	55	60	53	77	68

Mode	Free Inlet Combined w/Casing Radiated Octave Band Frequency (Hz)									
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**ARI50**	**ARI100**
Cooling Full		63	61	59	57	53	48	39	67	61
Heating Full		64	61	58	58	53	49	40	67	62
FAN Only		59	60	58	57	53	48	39	65	61

Notes:

All performance is sound power level in dB referenced to 1 picoWatt.
Data based on sound measurements made in a reverberant room on representative units from each cabinet size in accordance with ARI standard 260-2000.

Detailed Performance Report For HP-FCV060

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-FCV060**	
Quantity:	**1**	
Part Number:	**50PSV060DWC3ADEY**	
Unit Size:	**5 tons, 2000 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**15.**	gpm
Fluid Pressure Drop:	**11.7**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.50**	in wg
Filter Air Pressure Drop:	**.09**	in wg

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**134.**	Amps
Compressor RLA:	**25.**	Amps
Fan FLA:	**7.6**	Amps
Total FLA:	**32.6**	Amps
Max fuse amps:	**60**	Amps
Min Circuit Amps:	**39**	Amps
Min/Max Voltage:	**187/253**	Volts

Design Requirements

Cooling

Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp.:	**80.6**	F
Cooling Ent. Air WB Temp.:	**66.2**	F

Heating

Loop Temp Heating:	**70.0**	F
Heating Ent. air DB Temp.:	**68.0**	F

Fan Configuration

Fan Speed: **LOW**

Cooling

Airflow:	**1,695.0**	CFM
Total Cooling:	**64.0**	MBH
Sensible Cooling:	**47.4**	MBH
Cooling KW:	**2.8**	kW
EER:	**19.1**	Btuh/W
Leaving Air DB Temp.:	**54.4**	F
Leaving Air WB Temp.:	**53.4**	F
Cooling LWT:	**79.6**	F
Heat of Rejection:	**72.2**	MBH

Heating

Airflow:	**1,695.0**	CFM
Total Heating:	**79.2**	MBH
Heating KW:	**4.3**	kW
COP:	**5.5**	
Heating Leaving air Temp.:	**111.7**	F
Heating LWT:	**61.1**	F
Heat of Absorbtion:	**66.7**	MBH

Fan Configuration

Fan Speed: **MED**

Cooling

Airflow:	**1,960.0**	CFM
Total Cooling:	**65.9**	MBH
Sensible Cooling:	**51.2**	MBH
Cooling KW:	**2.8**	kW
EER:	**19.4**	Btuh/W
Leaving Air DB Temp.:	**56.2**	F
Leaving Air WB Temp.:	**55.0**	F
Cooling LWT:	**79.9**	F
Heat of Rejection:	**74.1**	MBH

Heating

Airflow:	**1,960.0**	CFM
Total Heating:	**80.5**	MBH
Heating KW:	**4.1**	kW
COP:	**5.8**	
Heating Leaving air Temp.:	**106.4**	F
Heating LWT:	**60.9**	F
Heat of Absorbtion:	**68.5**	MBH

Fan Configuration

Fan Speed: **HI**

Cooling

Airflow:	**2,105.0**	CFM
Total Cooling:	**65.5**	MBH
Sensible Cooling:	**52.9**	MBH
Cooling KW:	**2.8**	kW
EER:	**19.2**	Btuh/W
Leaving Air DB Temp.:	**57.1**	F
Leaving Air WB Temp.:	**55.9**	F
Cooling LWT:	**79.8**	F
Heat of Rejection:	**73.7**	MBH

Detailed Performance Report For HP-FCV060

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Heating

Airflow:	**2,105.0**	CFM	COP:	**5.9**	
Total Heating:	**81.0**	MBH	Heating Leaving air Temp.:	**104.0**	F
Heating KW:	**4.0**	kW	Heating LWT:	**60.8**	F
			Heat of Absorbtion:	**69.2**	MBH

HP-LHP010D

Tag Cover Sheet
Unit Report
Certified Drawing
Performance Report
Acoustic Summary
Detailed Performance Output Report

Unit Report For HP-LHP010D

Project: 15_smartWatt_WSHP
Prepared By: Brian W Meneghan

11/09/2015
12:04AM

Unit Parameters

Tag Name:	**HP-LHP010D**
Quantity:	**1**
Unit Model:	**50VQP**
Unit Size:	**10 tons, 4000 CFM**
Compressor Type:	**Puron 1-Stage**
Compressor Quantity:	**2**
Configuration:	**Vertical**
Capacity/Efficiency:	**Large Capacity**

Dimensions

Width:	**52.0**	in
Depth:	**42.0**	in
Height:	**62.0**	in
Shipping Weight:	**770.0**	lb
Operating Weight:	**725.0**	lb
Packaging:	**Domestic**	

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**145.**	Amps
Fan FLA:	**9.8**	Amps
Min Circuit Amps:	**69**	Amps
Max fuse amps:	**90**	Amps

Unit Options

AirFlow:	**Rear Return, Front Discharge**
Control:	**WSHP Open with C Microprocessor Control**
Coil:	**Copper**
Blower Drive:	**3HP Belt Drive**
Range/Sound:	**Standard Range (50 to 100 F) w/ Closed Cell Foam**
Performance Notes .:	**Acoustic data is not available for this unit.**

Warranty Information

2nd-5th Year Parts & Labor on complete unit
Start-up Each Unit

First Year - Parts Only (Standard):	**No Cost**
Five year compressor – Parts only (standard):	**No Cost**

Notes:

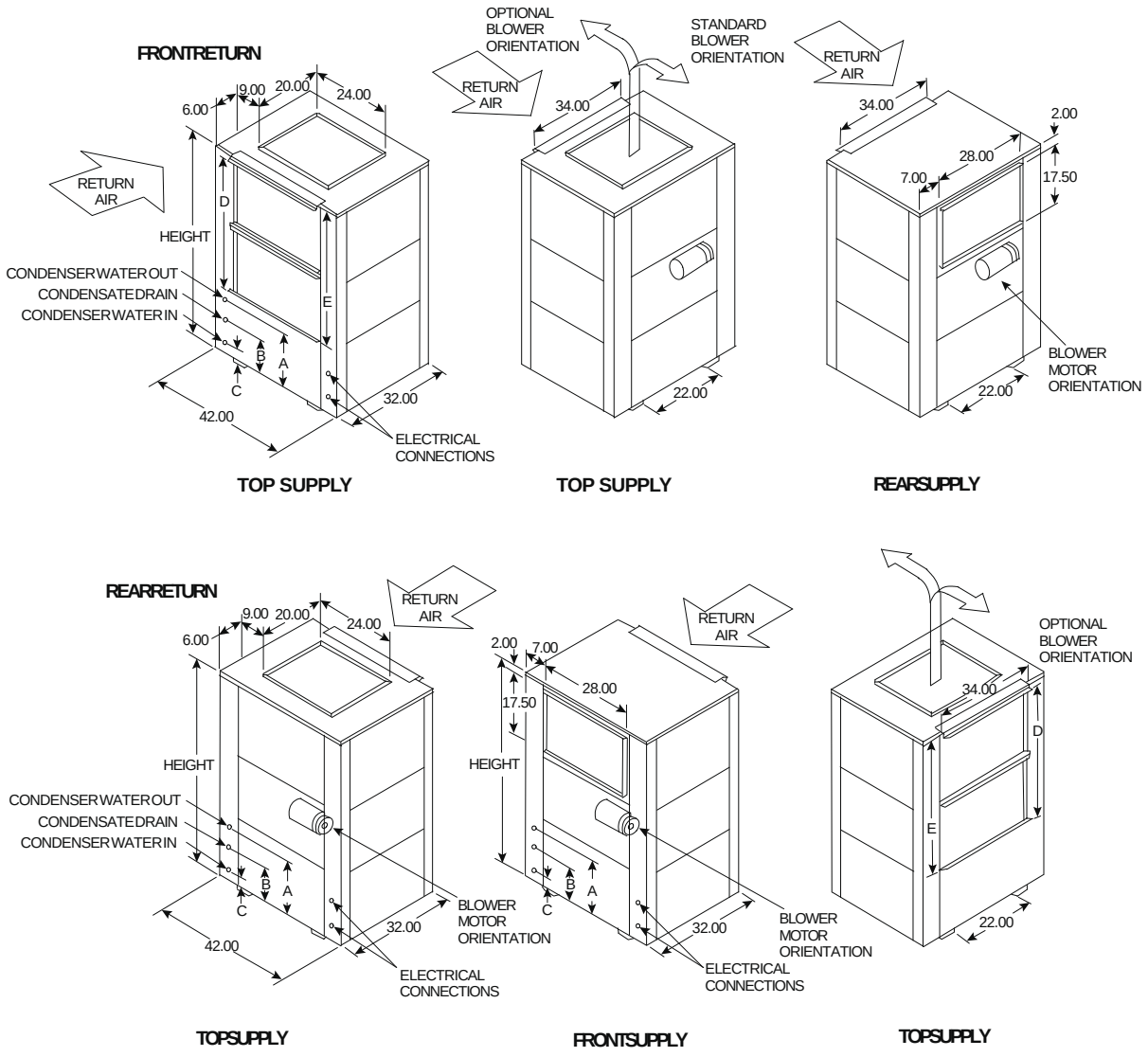
ZS Sensor must be used with WSHP Open to monitor space temperature.

Ordering Information

Part Number	Description	Quantity
Base Unit		
50VQP120SWB3A1EC	Standard Vertical Large Capacity Water Source Heat Pump 10 tons. 4000 CFM 208/230-1-60	1
Factory Options		
	Control: WSHP Open with C Microprocessor Control	
	Blower Drive: 3HP Belt Drive	
	Range/Sound: Standard Range (50 to 100 F) w/ Closed Cell Foam	

	Economizer	
Accessories		
ZS-H-CAR	ZS Standard	1
AHB1502-1500	Hose Kit with Isolation Valves and Auto Flow Regulator, 1-1/2 in. diameter, 15.0 GPM	1
23B0041N01	Motorized Water Valve	1

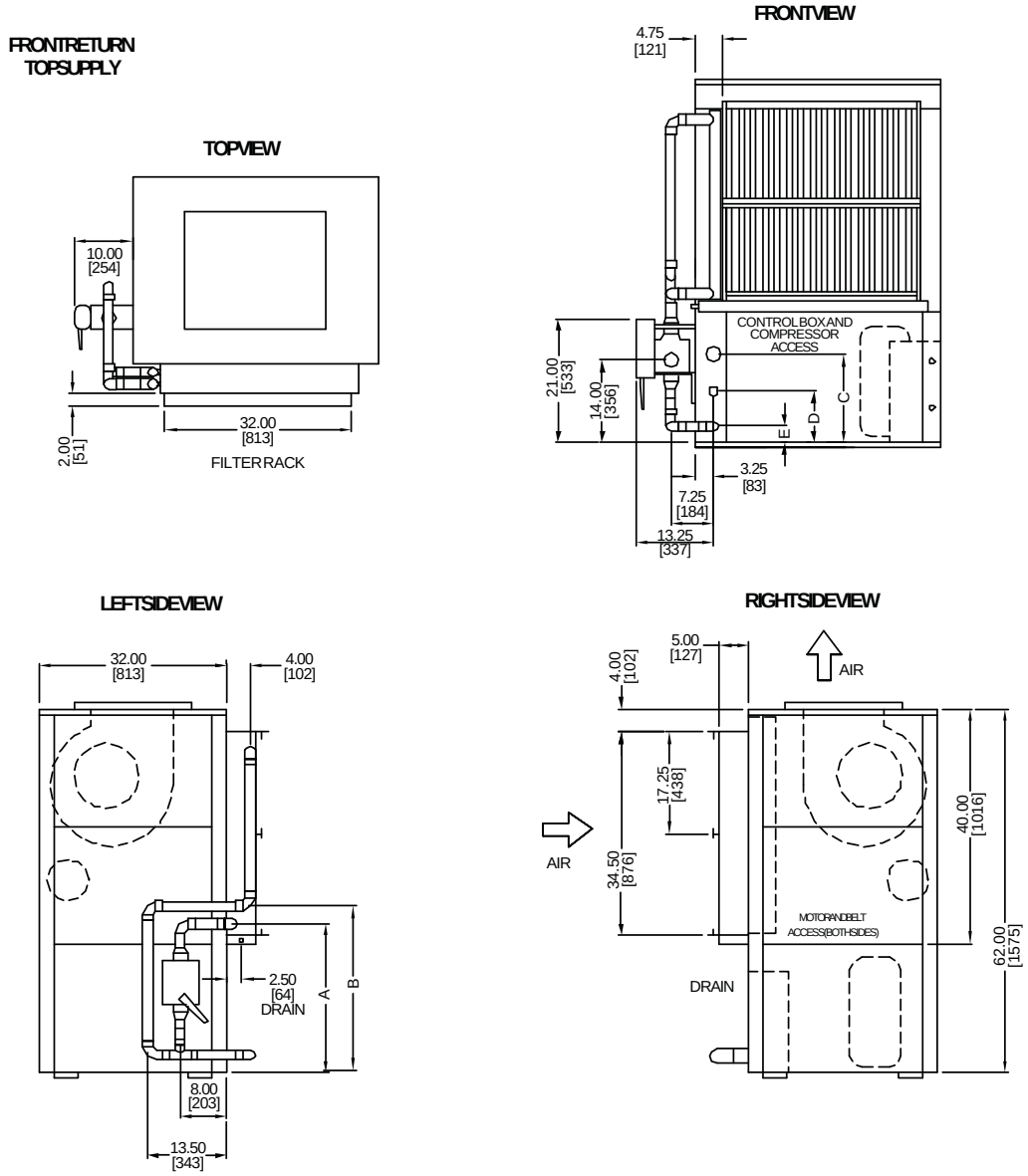
50VQP072-120UNITS



UNIT SIZE	HEIGHT	WIDTH	DEPTH	CONDENSERWATERCONNECTIONS				DUCT FLANGE	FILTER RACK	REPLACEMENT FILTERSIZE (NOMINAL)
				A	B	C	Diameter (FPT)	D	E	
072	62.00	42.00	32.00	14.75	8.50	2.75	1	38.00	40.00	20x34 $^{1}/_{2}$x1(2)
096	62.00	42.00	32.00	14.75	2.75	2.75	1			
120	62.00	42.00	32.00	15.00	9.00	3.00	$1^{1}/_{2}$			

NOTES:
1. All dimensions in inches unless otherwise noted. All dimensions within ±0.125-in. Specifications subject to change without notice. Condensate connections are 0.75in. FPT on sizes 072 through 120.
2. Front of unit is side with water and electrical connections.

50VQP072-120UNITSWITHECONOMIZER



50VQPSIZE	072 and 096	120
FILTERQTY&SIZE	(2)17"x34-1/2"x1"	(2)17"x34-1/2"x1"
CONDENSATECONN.	3/4"FPT	3/4"FPT
WATERCONN.	1"FPT	1-1/2"FPT
E	2.75"	3"
D	8.5"	9"
C	14.75"	15"
B	27"	27"
A	24"	24"

Performance Summary For HP-LHP010D

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-LHP010D**	
Quantity:	**1**	
Part Number:	**50VQP120SWB3A1EC**	
Unit Size:	**10 tons, 4000 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**30.**	gpm
Fluid Pressure Drop:	**15.1**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.50**	in wg
Economizer Air Pressure Drop:	**.24**	in wg

Performance Notes .: **Acoustic data is not available for this unit.**

Cooling

Airflow:	**3,320.0**	CFM
Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp:	**80.6**	F
Cooling Ent. Air WB Temp:	**66.2**	F
Total Cooling:	**131.8**	MBH
Sensible Cooling:	**95.8**	MBH
Cooling EER:	**18.5**	Btuh/W
Cooling KW:	**6.43**	kW
Heat of Rejection:	**150.7**	MBH
Cooling LAT DB:	**53.6**	F
Cooling LAT WB:	**52.6**	F
Cooling LWT:	**80.0**	F
ARI/ISO 13256-1 WLHP Cooling:	**124.0**	MBH
ARI/ISO 13256-1 WLHP EER:	**13.2**	Btuh/W
ARI/ISO 13256-1 GWHP Cooling:	**134.0**	MBH
ARI/ISO 13256-1 GWHP EER:	**18.3**	Btuh/W
ARI/ISO 13256-1 GLHP Cooling:	**127.2**	MBH
ARI/ISO 13256-1 GLHP EER:	**14.7**	Btuh/W

Note

"WLHP" = Water Loop Heat Pump (Boiler/Tower)
"GWHP" = Ground Water Heat Pump (Open Loop)
"GLHP" = Ground Loop Heat Pump (Geothermal)

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor Quantity:	**2**	
Compressor LRA:	**145.**	Amps
Compressor RLA:	**26.3**	Amps
Fan FLA:	**9.8**	Amps
Total FLA:	**36.1**	Amps
Max fuse amps:	**90**	Amps
Min Circuit Amps:	**69**	Amps
Min/Max Voltage:	**187/253**	Volts
Fan Motor:	**3.0**	hp
Fan RPM:	**706**	
Fan BHP:	**.94**	BHP

Heating

Airflow:	**3,320.0**	CFM
Loop Temp Heating:	**70.0**	F
Heating Ent. Air DB Temp:	**68.0**	F
Heating LAT:	**112.5**	F
Total Heating:	**158.2**	MBH
Heating COP:	**4.7**	
Heating KW:	**9.78**	kW
Heat of Absorption:	**129.5**	MBH
Heating LWT:	**61.4**	F
ARI/ISO 13256-1 WLHP Heating:	**158.0**	MBH
ARI/ISO 13256-1 WLHP COP:	**4.4**	
ARI/ISO 13256-1 GWHP Heating:	**123.0**	MBH
ARI/ISO 13256-1 GWHP COP:	**3.9**	
ARI/ISO 13256-1 GLHP Heating:	**100.0**	MBH
ARI/ISO 13256-1 GLHP COP:	**3.2**	

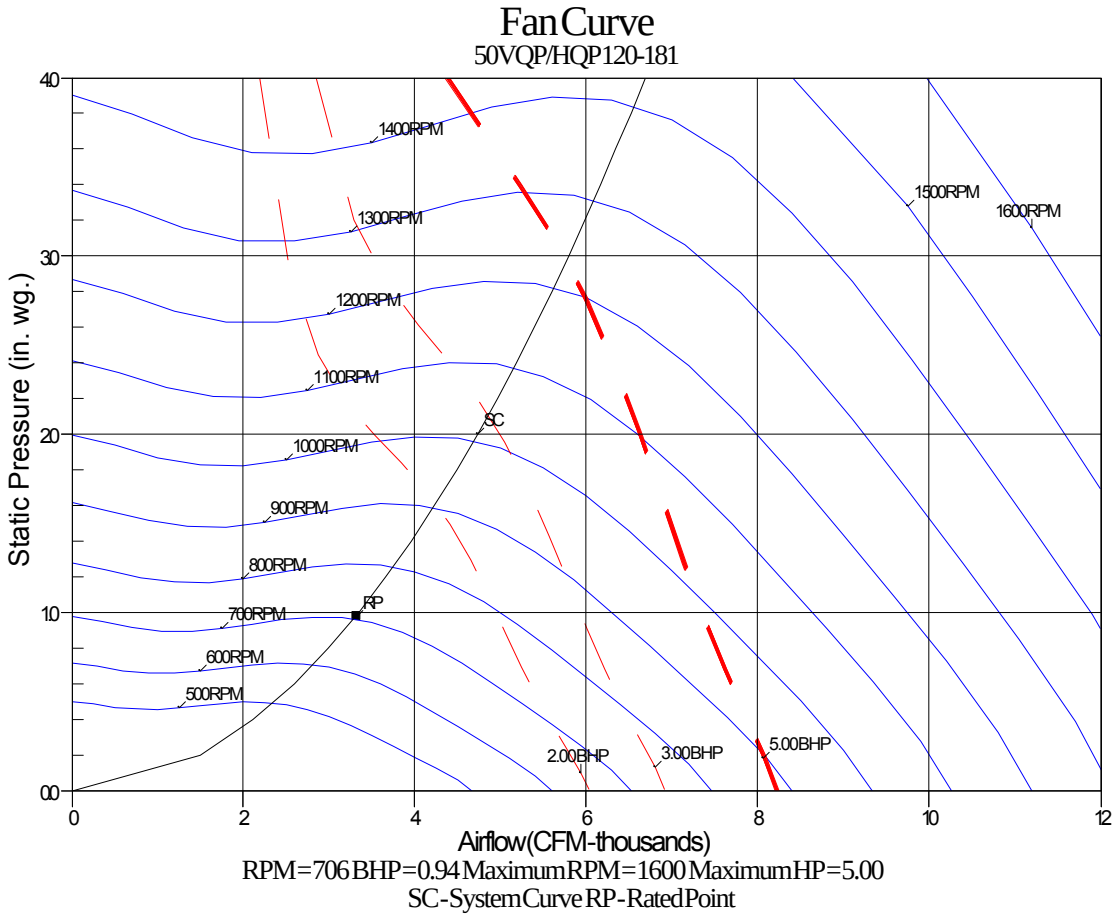
Economizer Mode

Airflow:	**3,320.0**	CFM
Economizer Ent. Water Temp.:	**50.0**	F
Ent. Air DB Temp.:	**80.6**	F
Ent. Air WB Temp.:	**66.2**	F
Total Cooling:	**89.0**	MBH
Sensible Cooling:	**71.2**	MBH
Leaving Air DB Temp.:	**60.6**	F
Leaving Air WB Temp.:	**57.4**	F
Economizer LWT:	**56.1**	F
Economizer Mode WPD:	**22.7**	ft wg

Performance Summary For HP-LHP010D

Project: 15_smartWatt_WSHP
Prepared By: Brian W Meneghan

11/09/2015
12:04AM



RPM=706 BHP=0.94 Maximum RPM=1600 Maximum HP=5.00
SC-System Curve RP-Rated Point

HP-WMH019C

Tag Cover Sheet
Unit Report
Certified Drawing
Performance Report
Acoustic Summary
Detailed Performance Output Report

Unit Report For HP-WMH019C

Project: 15_smartWatt_WSHP
Prepared By: Brian W Meneghan

11/09/2015
12:04AM

Unit Parameters

Tag Name:	**HP-WMH019C**
Quantity:	**3**
Unit Model:	**50PEC**
Unit Size:	**0.75 tons, 350 CFM**
Compressor Type:	**Puron 1-Stage**
Compressor Quantity:	**1**
Configuration:	**Console**
Capacity/Efficiency:	**Premium Efficiency**
Fan Speed:	**HI**

Dimensions

Width:	**48.0**	in
Depth:	**12.0**	in
Height:	**23.9**	in
Shipping Weight:	**151.0**	lb
Operating Weight:	**131.0**	lb
Packaging:	**Domestic**	

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**22.2**	Amps
Fan FLA:	**.7**	Amps
Min Circuit Amps:	**5**	Amps
Max fuse amps:	**15**	Amps

Unit Options

Water Circuit:	**Right hand Water Connection, 5/8" sweat connection**
Cabinet and Subbase:	**Standard 48" Cabinet and Subbase**
Control:	**WSHP Open with C Microprocessor Control**
Refrigerant Circuit:	**Copper, Coated Evap (Epoxy)**
Operating Range and Sound:	**Extended Range**
Factory Installed Options:	**OA Damper and Cleanable Mesh Filter**
Performance Notes .:	**Acoustic data is not available for this unit.**

Warranty Information

2nd-5th Year Parts & Labor on complete unit
Start-up Each Unit

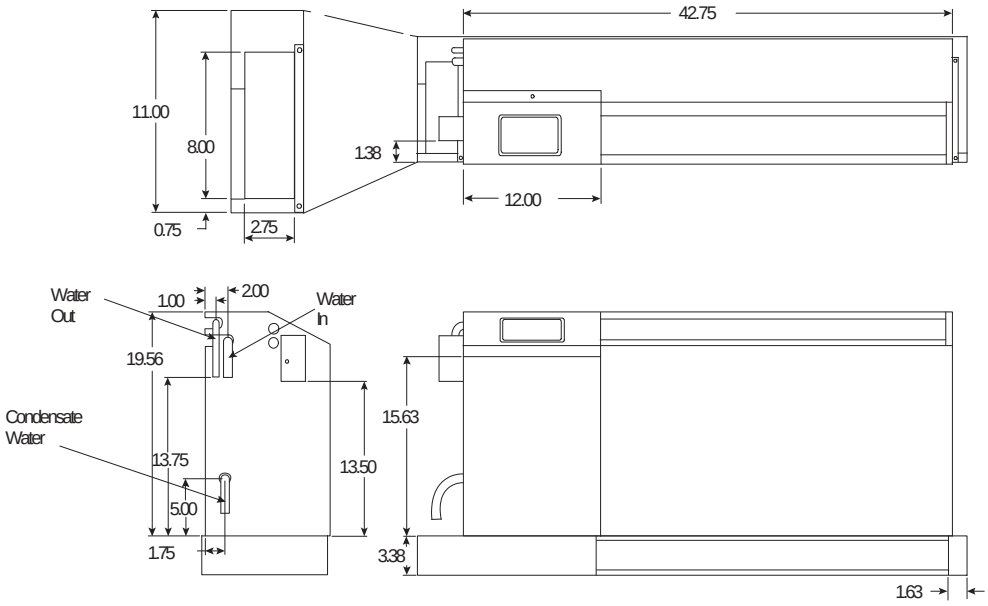
First Year - Parts Only (Standard):	**No Cost**
Five year compressor – Parts only (standard):	**No Cost**

Ordering Information

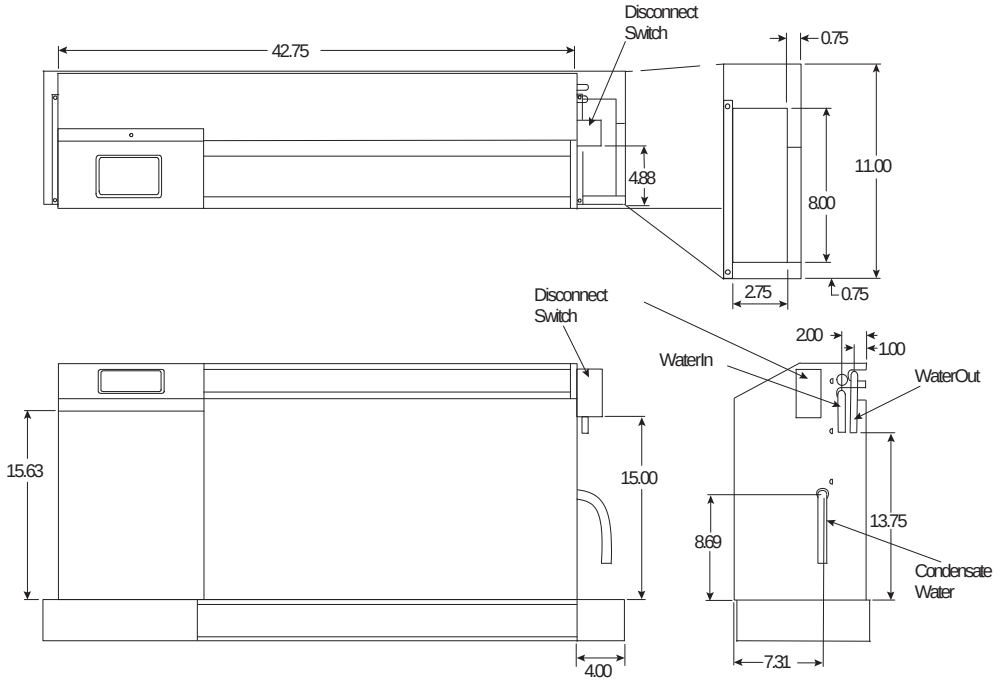
Part Number	Description	Quantity
Base Unit		
50PEC09AXWECA1AA	Console Water Source Heat Pump 0.75 tons. 350 CFM 208/230-1-60	3
Factory Options		
	Control: WSHP Open with C Microprocessor Control	
	Factory Installed Options: OA Damper and Cleanable Mesh Filter	
Accessories		
ZS-H-CAR	ZS Standard	3

50PEC09-18UNITCHASSIS(48in.CabinetOption)

LEFTHANDWATER

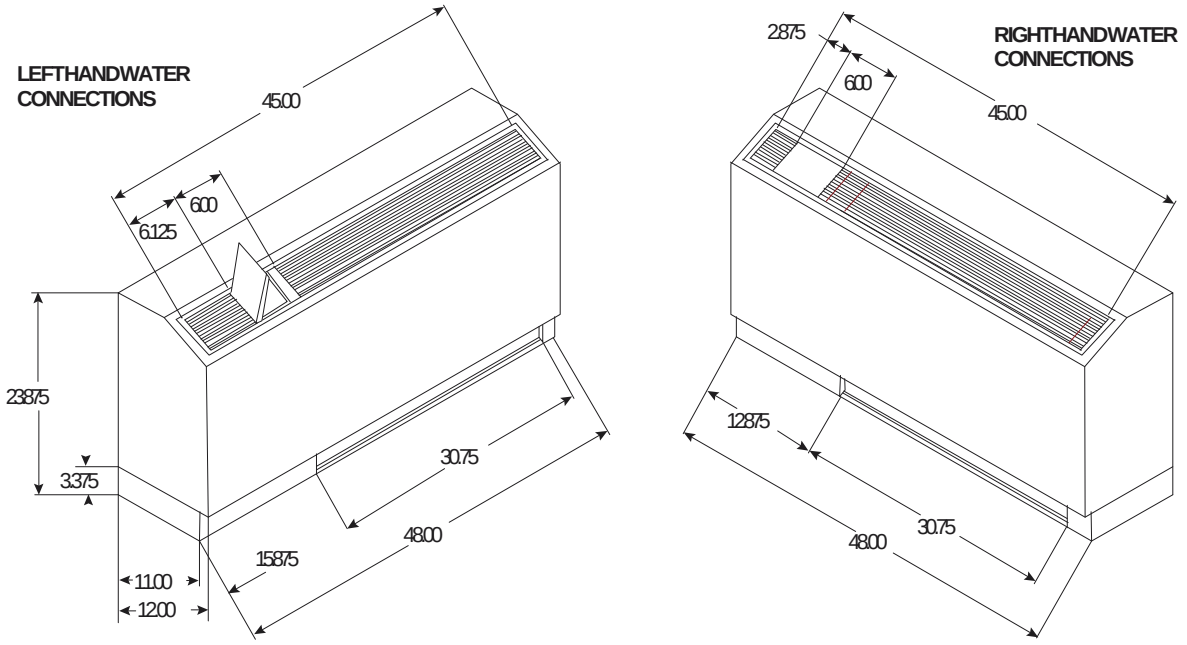


RIGHTHANDWATER



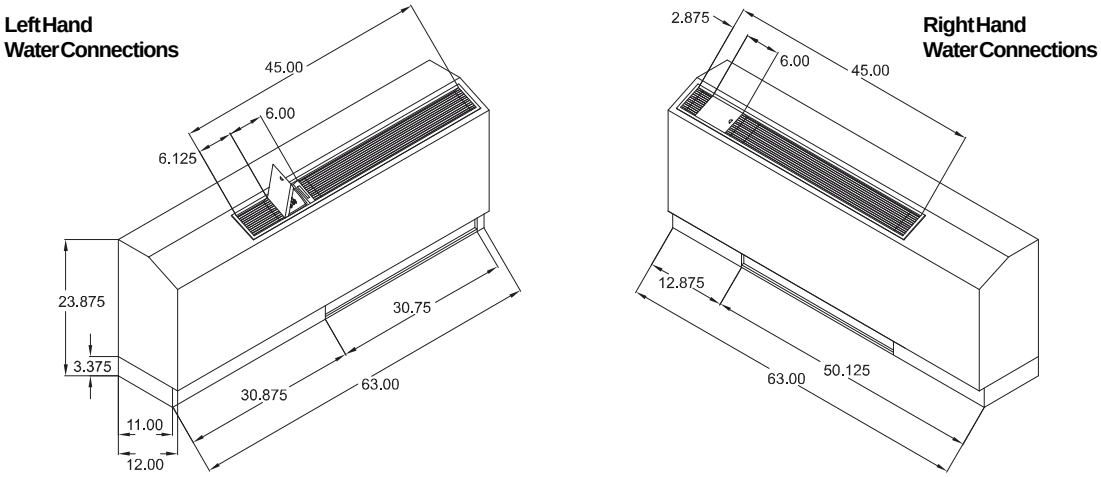
NOTES:
1. All dimensions are within ±0.125 inch.
2. Console units must be installed with a cabinet and subbase.
3. Unit controller shown, other control options may have a different control panel configuration.
4. Specifications subject to change without notice.

50PEC09-18UNITCONSOLE(48in.CabinetOption)



NOTES:
1. All dimensions within ±0.125 inches.
2. Specifications subject to change without notice.

50PEC09-18UNITCONSOLE(63in.CabinetOption)



NOTES:
1. All dimensions are in inches. All dimensions are within ±0.125 inch.
2. Specifications subject to change without notice.
3. Fresh air opening in subbase rear.
4. When installing units in cold climates, an outside air damper must be provided to prevent possible condenser freeze-up.

Performance Summary For HP-WMH019C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-WMH019C**	
Quantity:	**3**	
Part Number:	**50PEC09AXWECA1AA**	
Unit Size:	**0.75 tons, 350 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**2.3**	gpm
Fluid Pressure Drop:	**6.0**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.00**	in wg
Fan Speed:	**HI**	

Performance Notes .:**Acoustic data is not available for this unit.**

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor Quantity:	**1**	
Compressor LRA:	**22.2**	Amps
Compressor RLA:	**3.4**	Amps
Fan FLA:	**.7**	Amps
Total FLA:	**4.1**	Amps
Max fuse amps:	**15**	Amps
Min Circuit Amps:	**5**	Amps
Min/Max Voltage:	**187/253**	Volts
Fan Power:	**0.075**	kW

Cooling

Airflow:	**350.0**	CFM
Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp:	**80.6**	F
Cooling Ent. Air WB Temp:	**66.2**	F
Total Cooling:	**10.2**	MBH
Sensible Cooling:	**8.2**	MBH
Cooling EER:	**20.5**	Btuh/W
Cooling KW:	**.42**	kW
Heat of Rejection:	**11.4**	MBH
Cooling LAT DB:	**58.6**	F
Cooling LAT WB:	**56.6**	F
Cooling LWT:	**80.2**	F

Heating

Airflow:	**350.0**	CFM
Loop Temp Heating:	**70.0**	F
Heating Ent. Air DB Temp:	**68.0**	F
Heating LAT:	**98.1**	F
Total Heating:	**11.3**	MBH
Heating COP:	**5.4**	
Heating KW:	**.62**	kW
Heat of Absorption:	**9.5**	MBH
Heating LWT:	**61.6**	F

Note

"WLHP" = Water Loop Heat Pump (Boiler/Tower)
"GWHP" = Ground Water Heat Pump (Open Loop)
"GLHP" = Ground Loop Heat Pump (Geothermal)

Detailed Performance Report For HP-WMH019C

Project: 15_smartWatt_WSHP 11/09/2015
Prepared By: Brian W Meneghan 12:04AM

Unit Parameters

Tag Name:	**HP-WMH019C**	
Quantity:	**3**	
Part Number:	**50PEC09AXWECA1AA**	
Unit Size:	**0.75 tons, 350 CFM**	
Fluid Type:	**Water**	
Fluid Flow Rate:	**2.3**	gpm
Fluid Pressure Drop:	**6.0**	ft wg
Altitude:	**272**	ft
External Static Pressure:	**.00**	in wg

Performance Notes .:**Acoustic data is not available for this unit.**

Electrical

Voltage:	**208/230-1-60**	V-Ph-Hz
Compressor LRA:	**22.2**	Amps
Compressor RLA:	**3.4**	Amps
Fan FLA:	**.7**	Amps
Total FLA:	**4.1**	Amps
Max fuse amps:	**15**	Amps
Min Circuit Amps:	**5**	Amps
Min/Max Voltage:	**187/253**	Volts

Design Requirements

Cooling

Loop Temp Cooling:	**70.0**	F
Cooling Ent. Air DB Temp.:	**80.6**	F
Cooling Ent. Air WB Temp.:	**66.2**	F

Heating

Loop Temp Heating:	**70.0**	F
Heating Ent. air DB Temp.:	**68.0**	F

Fan Configuration

Fan Speed: **LOW**

Cooling

Airflow:	**320.0**	CFM
Total Cooling:	**10.1**	MBH
Sensible Cooling:	**7.9**	MBH
Cooling KW:	**.4**	kW
EER:	**20.2**	Btuh/W
Leaving Air DB Temp.:	**57.6**	F
Leaving Air WB Temp.:	**55.8**	F
Cooling LWT:	**80.0**	F
Heat of Rejection:	**11.3**	MBH

Heating

Airflow:	**320.0**	CFM
Total Heating:	**11.2**	MBH
Heating KW:	**.6**	kW
COP:	**5.2**	
Heating Leaving air Temp.:	**100.7**	F
Heating LWT:	**61.7**	F
Heat of Absorbtion:	**9.3**	MBH

Fan Configuration

Fan Speed: **HI**

Cooling

Airflow:	**350.0**	CFM
Total Cooling:	**10.2**	MBH
Sensible Cooling:	**8.2**	MBH
Cooling KW:	**.4**	kW
EER:	**20.5**	Btuh/W
Leaving Air DB Temp.:	**58.6**	F
Leaving Air WB Temp.:	**56.6**	F
Cooling LWT:	**80.2**	F
Heat of Rejection:	**11.4**	MBH

Heating

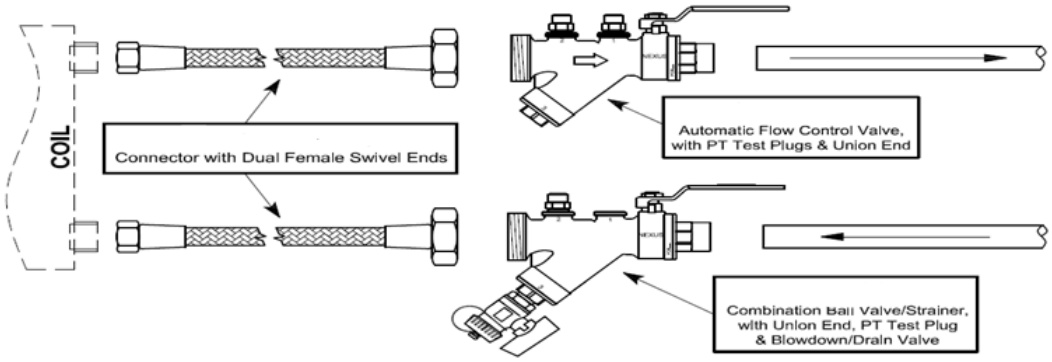
Airflow:	**350.0**	CFM
Total Heating:	**11.3**	MBH
Heating KW:	**.6**	kW
COP:	**5.4**	
Heating Leaving air Temp.:	**98.1**	F
Heating LWT:	**61.6**	F
Heat of Absorbtion:	**9.5**	MBH

Stainless Steel Hose Kit

AHC** 1/2" to 2" Stainless Steel Braided Hose Kit –** Hose kit with a manual shut off valve, auto flow regulator to maintain set GPM and Y strainer for hard water applications. Automatic balancing valves provide a constant flow rate; if the pressure changes (ex. Additional heat pumps) each flow control valve will adjust to the conditions. The Y strainer can filter water with high mineral content which can cause damage over time to equipment.

Specifications:

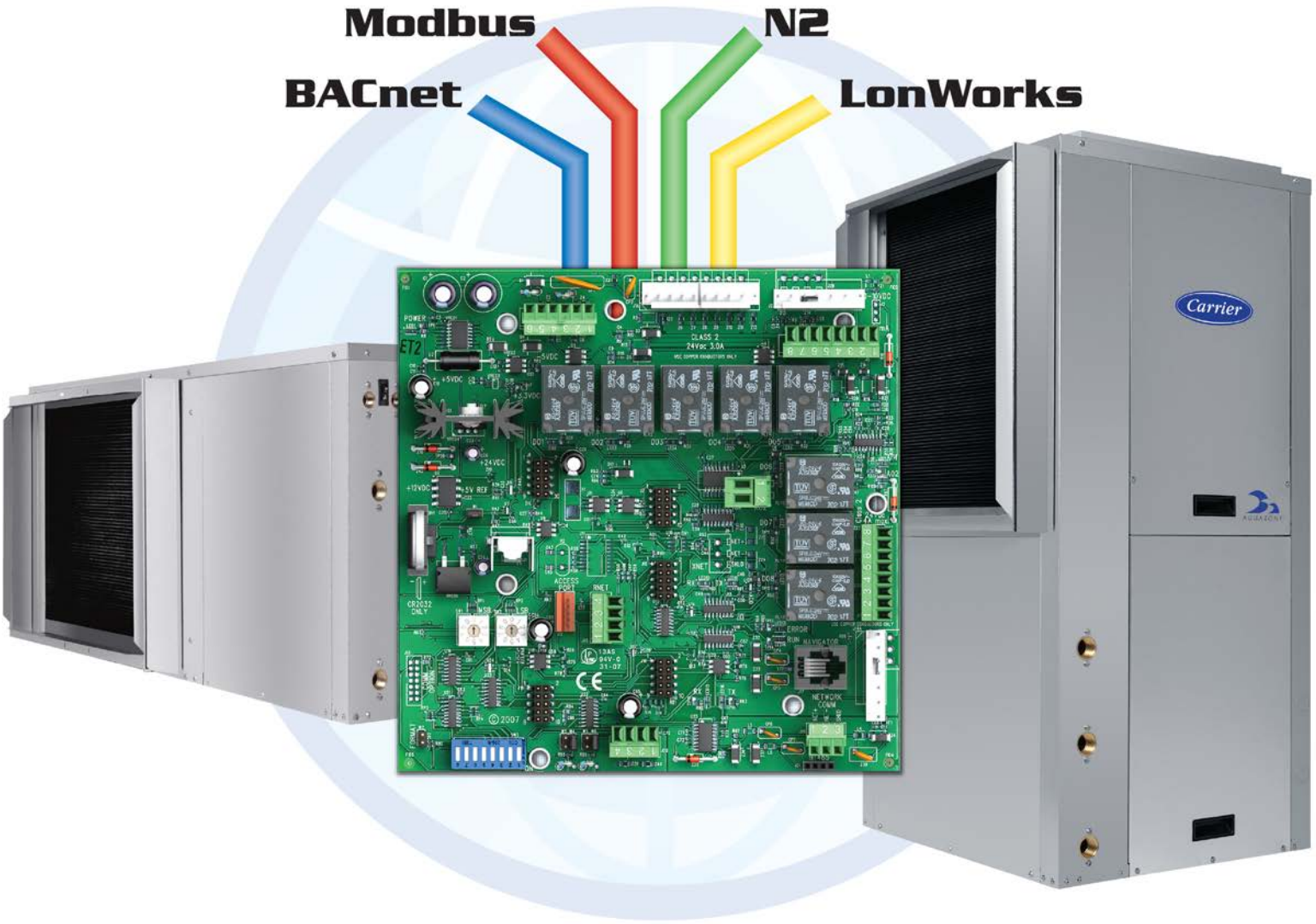
- Designed for water source heat pump applications.
- Kevlar® reinforced EPDM hose core with stainless steel hose braid
- Swivel connection with dual female ends provides union between heat pump and piping system.
- Brass OT58 fittings
- Ball valve with integral P/T (pressure/temperature) ports and union end



AHC - Stainless Steel Hose Kit			
Kit Includes	Supply Side: Combination Ball Valve/Strainer with P/T plug, 24" stainless steel hose, blowdown/drain valve and swivel end		
	Return Side: Ball Valve with P/T plug, automatic flow control valve , 24" stainless steel hose, and swivel ends		
Model Number	Models available	Diameter (in.)	Length (in.)
AHC0502	50PEC 009-018	1/2	24
AHC0752	50PC 007-042 50PS 007-024 50PT 024 50PSW 025-035	3/4	24
AHC1002	50PC 048-070 50PS 036-070 50PT 036-070 50PSW 049-071 50HQP/VQP 072-096	1	24
AHC1252	50PSW 122 50HQP 120	1 1/4	24
AHC1502	50PSW 180-210 50HQP 150-180 50VQP 120-181	1 1/2	24
AHC2002	50HQP 242 50VQP 210-360 50PSW 240-420	2	24

Physical Data			
Model Number	Working Pressure (psi)	Min. Burst Pressure (psi)	Min. Bend Radius (in.)
AHC0502	400	1600	3.562
AHC0752	400	1600	3.562
AHC1002	400	1600	4.375
AHC1252	300	1200	5.125
AHC1502	300	1200	7.125
AHC2002	300	1200	9.5

WSHP Open v3
Integration Guide



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 Verify that you have the most current version of this document from **www.hvacpartners.com** or your local Carrier office.

Important changes are listed in **Document revision history** at the end of this document.

Contents

Introduction

What is the WSHP Open controller?

The Water Source Heat Pump (WSHP) controller is available as an integrated component of a Carrier packaged unit. Its internal application programming provides optimum performance and energy efficiency. WSHP Open enables the unit to run in 100% stand-alone control mode or it can communicate to the Building Automation System (BAS).

On board DIP switches allow you to select the baud rate and choose one of the following protocols:

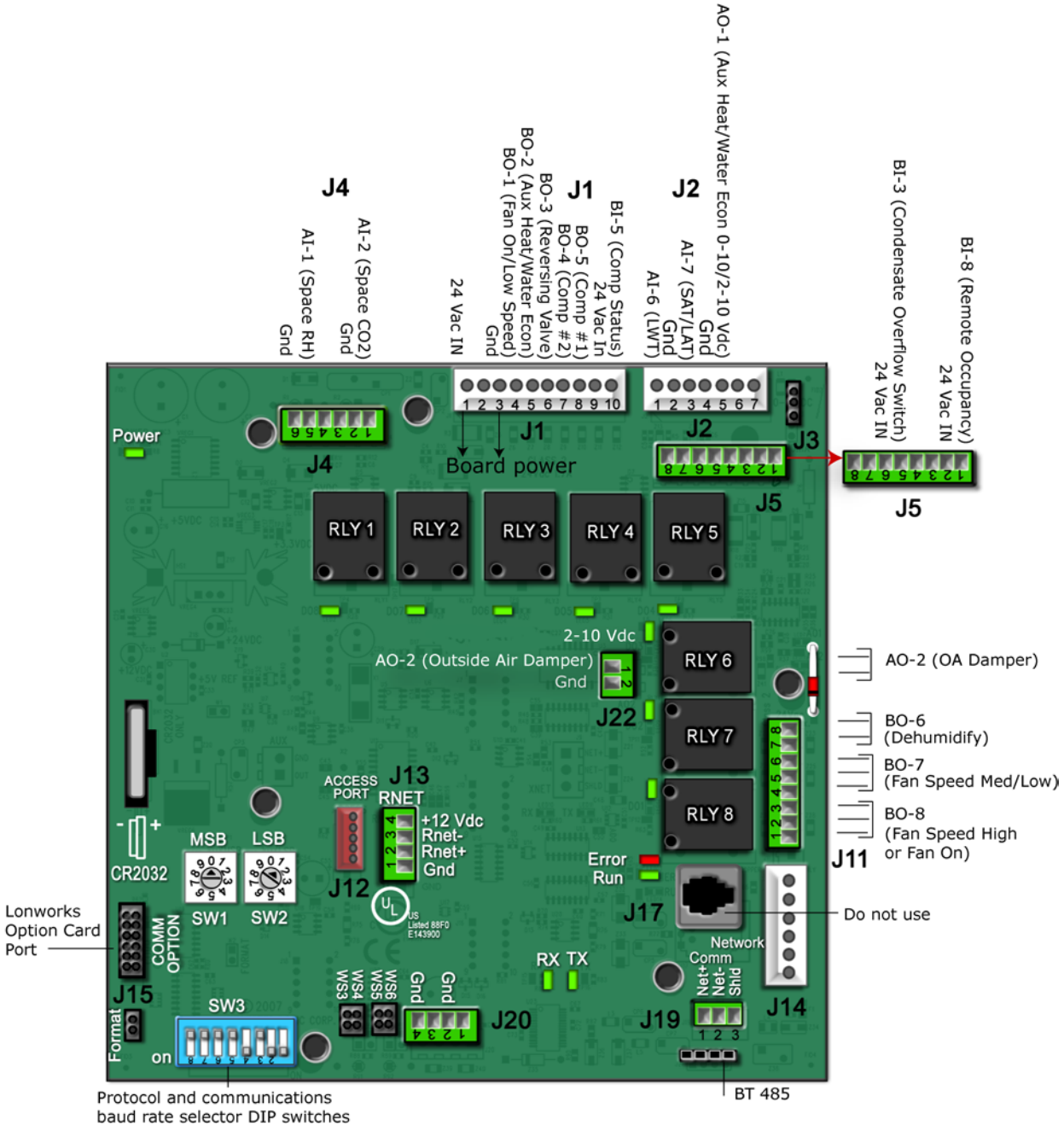
- BACnet
- Modbus
- Johnson N2
- LonWorks

The Equipment Touch is a touchscreen device with a 4.3 in. color LCD display that you connect to one of the following controllers to view or change its property values, schedule equipment, view trends and alarms, and more, without having to access the system's server.

You can use Carrier’s Equipment Touch user interface with the WSHP Open controller using the 5-pin J12 Access Port. See illustration below.

The WSHP Open's application supports detailed color graphics, status, properties, alarms, trends, performance, configuration, and Help on the Equipment Touch. In addition, the WSHP Open Startup Wizard has screens to facilitate the installation technician to initially configure the WSHP Open.

For more details about the Equipment Touch, see the *Equipment Touch Installation and Setup Guide*.


J4
AI-1 (Space RH)
Gnd
AI-2 (Space CO2)
Gnd
24 Vac IN
BO-1 (Fan On/Low Speed)
Gnd
BO-2 (Aux Heat/Water Econ)
BO-3 (Reversing Valve)
BO-4 (Comp #2)
BO-5 (Comp #1)
24 Vac In
BI-5 (Comp Status)
J1
AI-6 (LWT)
Gnd
AI-7 (SAT/LAT)
Gnd
AO-1 (Aux Heat/Water Econ 0-10/2-10 Vdc)
J2
24 Vac IN
BI-3 (Condensate Overflow Switch)
24 Vac IN
BI-8 (Remote Occupancy)
J3
J5
Power
Board power
RLY 1
RLY 2
RLY 3
RLY 4
RLY 5
2-10 Vdc
AO-2 (Outside Air Damper)
Gnd
J22
RLY 6
RLY 7
RLY 8
AO-2 (OA Damper)
BO-6
(Dehumidify)
BO-7
(Fan Speed Med/Low)
BO-8
(Fan Speed High
or Fan On)
J11
ACCESS PORT
J13
RNET
+12 Vdc
Rnet-
Rnet+
Gnd
J12
CR2032
MSB
LSB
SW1
SW2
Error
Run
J17
Do not use
Lonworks
Option Card
Port
COMM OPTION
J15
Format
SW3
on
WS3
WS4
WS5
WS6
Gnd
Gnd
J20
RX TX
Network
Comm
Net+
Net-
Shld
J19
J14
BT 485
Protocol and communications
baud rate selector DIP switches

Safety considerations & handling warning

WARNING

When you handle the WSHP Open:

- Do not contaminate the printed circuit board with fingerprints, moisture, or any foreign material.
- Do not touch components or leads.
- Handle the board by its edges.
- Isolate from high voltage or electrostatic discharge.
- Ensure that you are properly grounded.

Wiring inputs and outputs

WSHP Open Inputs and Outputs Table

Input/Output Type	Part Numbers	Type of I/O		Connection Pin Numbers	I/O Channel
Inputs					
Zone Sensors ZS Sensors	Temp only: ZS-CAR / ZSPL-CAR / ZSP-CAR Temp and CO2: ZS-C-AR / ZSP-C-CAR / ZSP-C-CAR Temp and RH: ZS-H-CAR / ZSPL-H-CAR / ZSP-H-CAR Temp, RH, and CO2: ZS-HC-CAR / ZSPL-HC-CAR / ZSP-HC-CAR	Communicating		**J13**, 1 - 4	Rnet Port
SPT Sensors	SPS, SPPL, SPP				
Space Relative Humidity	33ZSENSRH-02	**AI** (4-20 mA)		**J4** - 5 & 6	AI - 1
Indoor Air Quality	33ZCSPTCO2	**AI** (4-20 mA)		**J4** - 2 & 3	AI - 2
Condensate Switch	N/A	**BI** (Dry Contacts)		**J1** - 2	BI - 3
Stage 1 Compressor Status	N/A	**BI** (Dry Contacts)		**J1** - 10	BI - 5
Leaving Source Water Temp	10K Type II	**AI** (10K Thermistor)		**J2** - 1 & 2	AI - 6
Supply Air Temperature	33ZCSENSAT	**AI** (10K Thermistor)		**J2** - 3 & 4	AI - 7
Supply Fan Status	N/A	**BI** (Dry Contacts)		**J5** - 1 & 2	BI - 8
Occupancy Contact	N/A	**BI** (Dry Contacts)		**J5** - 1 & 2	BI - 8
Smoke Detector Input**	N/A	24 Vac		**J1** - 9	24 Vac IN
Outputs					
Aux Heat - Modulating (HW Valve/Water Econ)	N/A	**AO** (0-10 Vdc/ 2-10 mA)	*	**J2** - 4 & 5	AO - 1
Outside Air Damper	N/A	**AO** (0-10 Vdc/ 2-10 mA)	*	**J22** - 1 & 2	AO - 2
Supply Fan On/ Low speed (3-speed only)	N/A	**BO** Relay (24 Vac, 3A)	*	**J1** - 4	BO - 1 (G)
W2-Aux Heat or 2-pos. Water Economizer	N/A	**BO** Relay (24 Vac, 3A)	*	**J1** - 5	BO - 2
Reversing Valve (B or O)	N/A	**BO** Relay (24 Vac, 3A)	*	**J1** - 6	BO - 3 (RV)
Y2-Compressor 2nd stage	N/A	**BO** Relay (24 Vac, 3A)		**J1** - 7	BO - 4 (Y2)
Y1-Compressor 1st stage	N/A	**BO** Relay (24 Vac, 3A)		**J1** - 8	BO - 5 (Y1)
Dehumidification Relay	N/A	**BO** Relay (24 Vac, 3A)	*	**J11** - 7 & 8 (N.O.)	BO - 6
Fan Speed Medium/Low (3-speed Only)	N/A	**BO** Relay (24 Vac, 3A)	*	**J11** - 5 & 6 (N.O.)	BO - 7

Input/Output Type	Part Numbers	Type of I/O		Connection Pin Numbers	I/O Channel
Fan Speed High/Low (3-speed Only)	N/A	**BO** Relay (24 Vac, 3A)	*	**J11** - 2 & 3 (N.O.)	BO - 8

Legend:

AI - Analog Input **AO** - Analog Output

BI - Digital Input **BO** - Digital Output

*	These outputs are configurable.
**	24 Vac required at this terminal to provide unit operation. Connect an isolated N.C. smoke detector contact (or jumper) between 24 Vac and **J1** - 9.

Communications wiring

Protocol overview

Protocols are the communication languages spoken by the control devices. The main purpose of a protocol is to communicate information in the most efficient method possible. Different protocols exist to provide specific information for different applications.

In the BAS application, many different protocols are used, depending on manufacturer. Different protocols do not change the function of the controller, but they typically require the owner to change systems or components in order to change from one protocol to another. The WSHP Open is an effective solution to minimize the amount of controllers that you may need to change in order to communicate with different types of protocols.

You can set the controller to communicate 1 of 4 different protocols:

- *BACnet MS/TP* (page 7)
- *Modbus* (page 11)
- *N2* (page 13)
- *LonWorks* (page 15)

The default setting is BACnet MS/TP. Switch 3 (**SW3**) on the board sets protocol and baud rate. Switches **MSB** (**SW1**) and **LSB** (**SW2**) set the board's network address. See table below for specific switch settings. The third party connects to the controller through port **J19** for BACnet MS/TP, Modbus, and N2, and through **J15** for the LonWorks Option Card.

NOTES

- Changing protocol requires no programming or point assignment by the installer or operator.
- Power must be cycled after changing the **MSB** (**SW1**) - **LSB** (**SW2**) settings or connecting the LonWorks Option Card to **J15**.

SW3 Switch Settings Table

		Protocol Selection						Baud Rate	
Protocol		**DS8**	**DS7**	**DS6**	**DS5**	**DS4**	**DS3**	**DS2**	**DS1**
BACnet MS/TP (Default)	Master	Unused	Off	Off	Off	On	Off	Select Baud	Select Baud
Modbus	Slave	Unused	Off	Off	On	On	Off	Select Baud	Select Baud
N2	Slave	Unused	Off	Off	Off	On	On	Off	Off
Lonworks		Unused	On	On	Off	On	Off	Off	On

Baud Selection Table

Baud Rate	SW3/DS2	SW3/DS1
9,600	Off	Off
19,200	On	Off
38,400	Off	On
76,800 (Default)	On	On

BACnet MS/TP

To set up the WSHP Open for BACnet MS/TP

Refer to *Appendix B* (page 39) for the Protocol Implementation Conformance Statement, or download the latest from *BACnet International http://www.bacnetinternational.net/catalog/index.php?m=28*.

NOTE This controller counts as a full load on the MS/TP bus.

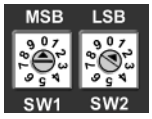
1 Turn **off** the WSHP Open's power.

NOTE Changes made to the switches when the controller is on will not take effect until the power is cycled!

2 Using the rotary switches **MSB** (**SW1**) and **LSB** (**SW2**), set a unique MS/TP MAC address for the WSHP Open. Set the **MSB** (**SW1**) switch to the tens digit of the address, and set the **LSB** (**SW2**) switch to the ones digit. Valid addresses are 01-99.

NOTE The rotary switches also determine the BACnet device instance of the controller on the BACnet network. The BACnet device instance is automatically generated based on the scheme 16101xx, where "16" is the BACnet vendor ID for Carrier Corporation, and xx equals the rotary switch address.

EXAMPLE To set the controller's MS/TP MAC address to 01, point the arrow on the **MSB** (**SW1**) switch to 0 and the arrow on the **LSB** (**SW2**) switch to 1. Internally, the BACnet device instance is automatically generated as 1610101.



3 Set the **SW3** Comm Selector DIP switches **DS1** and **DS2** for the appropriate communications speed (9600, 19.2k, 38.4k, or 76.8k bps).

NOTE Use the same baud rate and communication settings for all controllers on the network segment. The WSHP Open is fixed at 8 data bits, No Parity, and 1 Stop bit for this protocol's communications.

Baud Selection Table

Baud Rate	SW3/DS2	SW3/DS1
9,600	Off	Off
19,200	On	Off
38,400	Off	On
76,800	On	On

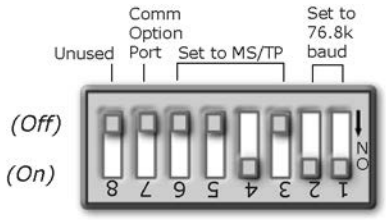
4 Set **SW3** Comm Selector DIP switches **DS3** through **DS6** for BACnet MS/TP. See table and example below.

5 Leave **DS7** and **DS8** in the OFF position. These switches are not applicable to MS/TP.

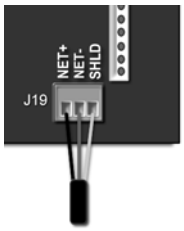
SW3 Protocol Switch Settings for MS/TP

DS8	DS7	DS6	DS5	DS4	DS3
Off	Off	Off	Off	On	Off

The following example shows the DIP switches set for 76.8k (Carrier default), and MS/TP.



6 Connect the MS/TP network to the controller's **J19** port. Connect to **Net+**, **Net-**, and **SHLD**.



Wire specifications

- A dedicated 22 AWG shielded twisted pair wire (EIA 485)
- Maximum wire length 2000 feet (610 meters) or 32 nodes
- Devices should be daisy-chained and not star-wired
- Attach the drain/shield wire to both ends of the network segment and through every controller

NOTE Use the same polarity throughout the network segment.

7 Turn **on** the WSHP Open's power.

Adjusting MS/TP properties using an Equipment Touch

You may need to adjust the following MS/TP Protocol timing settings using the Equipment Touch.

Max Masters - defines the highest MS/TP Master MAC address on the MS/TP network.

For example, if there are 3 master nodes on an MS/TP network, and their MAC addresses are 1, 8, and 16, then Max Masters would be set to 16 (since this is the highest MS/TP MAC address on the network).

This property optimizes MS/TP network communications by preventing token passes and “poll for master” requests to non-existent Master nodes.

In the above example, MAC address 16 knows to pass the token back to MAC address 1, instead of counting up to MAC address 127. Each MS/TP master node on the network must have their Max Masters set to this same value. The default is 127.

Max Info Frames - defines the maximum number of responses that will be sent when the WSHP Open receives the token. Any positive integer is a valid number. The default is 10 and should be ideal for the majority of applications. In cases where the WSHP Open is the target of many requests, this number could be increased as high as 100 or 200.

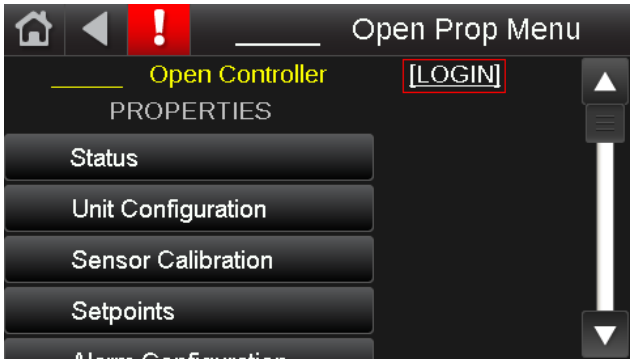
NOTES

- MS/TP networks can be comprised of both master and slave nodes. Valid MAC addresses for master nodes are 0 – 127 and valid addresses for Slave nodes are 0 - 254.
- If the third party attempts to communicate to the controller but does not get a response, make sure the controller is set as a BACnet MS/TP (m) master. The BACnet software asks the controllers, "Who Is?" This is to auto-locate devices on the network. Only controllers set as masters will answer this request.
- See Appendix A for Network Points List.
- See *Appendix B* (page 39) for the BACnet Protocol Implementation Conformance Statement (PICS).

To set the Device Instance number or adjust the Max Masters or Max Info Frames using an Equipment Touch

1 In the Equipment Touch interface, navigate to the **Properties Menu** screen and click **Login**.

NOTE The following graphic is generic and not specific to your system.



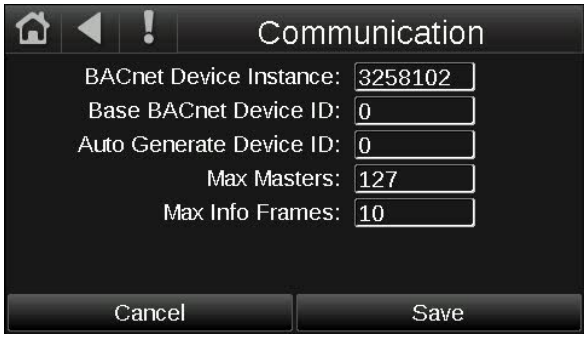
2 Type **Touch** for the password and click **Done**.

3 On the **Properties Menu** screen, scroll to the bottom of the list and click **ET System**.

4 On the **ET System** screen, click **Setup**.

5 On the **Setup** screen, click **Module Setup**.

6 On the **Module Setup** screen, click **Communication**.



On the **Communication** screen, edit the fields as needed:

7 Click the property box next to **BACnet Device Instance**, type the new number, and click **Done**.

8 Click the property box next to **Max Masters** and/or **Max Info Frames**, type a new value (1-127), and click **Done**.

9 Click **Save**.

Troubleshooting BACnet MS/TP

Check the following to troubleshoot your WSHP Open:

1 Verify that the BAS and controller are both set to speak the BACnet MS/TP protocol on the Comm Selector DIP switches **DS3 - DS6**.

2 Verify that the BAS and the controller are both set for the same baud rate:

- Baud rate DIP switches DS2 and DS1
- Obtain a Modstat of the controller. Scroll to the bottom of the page to **Network Communications** to view the active protocol and baud rate.

3 Verify that the BAS is configured to speak 2-wire EIA-485 to the controller. The BAS may have to configure jumper or DIP switches on their end.

4 Verify that the BAS and the controller have the same communication settings (8 data bits, No Parity, and 1 stop bit).

5 Verify proper connection wiring between the BAS and the controller.

6 Verify that the controller has a unique MAC address on the MS/TP bus. The controller's MS/TP MAC address is set by its rotary address switches.

7 Verify that the BAS is reading or writing to the proper BACnet objects in the controller. Refer to Appendix A for the points list for the controller.

8 BAS must be reading or writing to the proper addresses on the controller. Refer to Appendix A for the points list of the controller.

9 Verify that the BAS is sending his requests to the proper MS/TP MAC address of our controller.

10 Present the BAS company with a copy of the controller's BACnet PICS so that they know which BACnet commands are supported. Refer to Appendix B for the BACnet PICS. In certain situations, it may be necessary to adjust the MS/TP Protocol timing settings through the Equipment Touch device.

See the next section, if you need to adjust MS/TP Protocol timing settings using the Equipment Touch.

Modbus

To set up the WSHP Open for Modbus

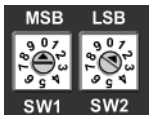
Refer to *Appendix C* (page 40) for the Modbus Protocol Implementation Conformance Statement (PICS).

1 Turn **off** the WSHP Open's power.

NOTE Changes made to the switches when the controller is on will not take effect until the power is cycled!

2 Using the rotary switches, set a unique Modbus slave address for the WSHP Open. Set the **MSB** (**SW1**) switch to the tens digit of the address, and set the **LSB** (**SW2**) switch to the ones digit. Valid Modbus slave addresses are 01-99.

EXAMPLE To set the controller's Modbus slave address to 01, point the arrow on the **MSB** (**SW1**) switch to 0 and the arrow on the **LSB** (**SW2**) switch to 1.



3 Set the **SW3** Comm Selector DIP switches **DS1** and **DS2** for the appropriate communications speed (9600, 19.2k, 38.4k, or 76.8k bps).

NOTE Use the same baud rate and communication settings for all controllers on the network segment. The WSHP Open is fixed at 8 data bits, No Parity, and 1 Stop bit for this protocol's communications.

Baud Selection Table

Baud Rate	SW3/DS2	SW3/DS1
9,600	Off	Off
19,200	On	Off
38,400	Off	On
76,800	On	On

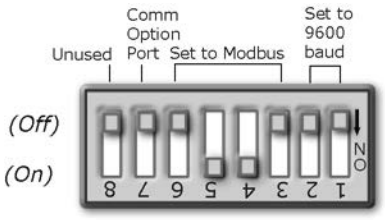
4 Set **SW3** Comm Selector DIP switches **DS3** through **DS6** for Modbus. See example below.

5 Leave **DS7** and **DS8** in the OFF position. These switches are not applicable to Modbus.

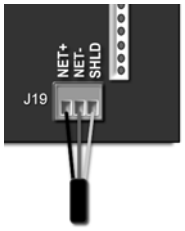
SW3 Protocol Switch Settings for Modbus

DS8	DS7	DS6	DS5	DS4	DS3
Off	Off	Off	On	On	Off

The following example shows the DIP switches set for 9600 baud and Modbus.



6 Connect the Modbus EIA-485 network to the WSHP Open's **J19** port. Connect to **Net+**, **Net-**, and **SHLD**.



Wire specifications

- A dedicated 22 AWG shielded twisted pair wire (EIA 485)
- Maximum wire length 2000 feet (610 meters) or 32 nodes
- Devices should be daisy-chained and not star-wired
- Attach the drain/shield wire to both ends of the network segment and through every controller

NOTE Use the same polarity throughout the network segment.

7 Turn **on** the WSHP Open's power.

Troubleshooting Modbus

Check the following to troubleshoot your WSHP Open:

1 Verify that the BAS and controller are both set to speak the Modbus RTU protocol on the Comm Selector DIP switches **DS3 - DS6**.

2 Verify that the BAS and the controller are both set for the same baud rate:

- Baud rate DIP switches DS2 and DS1
- Obtain a Modstat of the controller. Scroll to the bottom of the page to **Network Communications** to view the active protocol and baud rate.

3 Verify that the BAS is configured to speak 2-wire EIA-485 to the controller. The BAS may have to configure jumper or DIP switches on their end.

4 Verify that the BAS and the controller have the same communication settings (8 data bits, No Parity, and 1 stop bit).

5 Verify proper connection wiring between the BAS and the controller.

6 Verify that the rotary address switches are set for the controller's unique slave address.

7 BAS must be reading or writing to the proper point addresses on the controller.

8 BAS is sending requests to the proper slave address of the controller.

NOTE Refer to *Appendix C* (page 40) for the Protocol Implementation Conformance Statement.

Modbus Exception Codes that might be returned from this controller

Codes	Name	Description
01	Illegal Function	The Modbus function code used in the query is not supported by the controller.
02	Illegal Data Address	The register address used in the query is not supported by the controller.
04	Slave Device Failure	The Modbus Master has attempted to write to a non-existent register or a read-only register in the controller.

Johnson N2

To set up the WSHP Open for N2

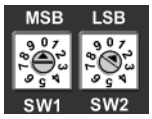
Refer to *Appendix D* (page 42) for the N2 Protocol Implementation Conformance Statement (PICS).

1 Turn **off** the WSHP Open's power.

NOTE Changes made to the switches when the controller is on will not take effect until the power is cycled!

2 Using the rotary switches, set a unique N2 slave address for the WSHP Open. Set the **MSB** (**SW1**) switch to the tens digit of the address, and set the **LSB** (**SW2**) switch to the ones digit. Valid N2 slave addresses are 01-99.

EXAMPLE To set the N2 slave address to 01, point the arrow on the **MSB** (**SW1**) switch to 0 and the arrow on the **LSB** (**SW1**) switch to 1.



3 Set the Comm Selector DIP switches **DS1** and **DS2** for the 9600 baud.

NOTE Use the same baud rate and communication settings for all controllers on the network segment. The WSHP Open is fixed at 9600 baud, 8 data bits, No Parity, and 1 Stop bit.

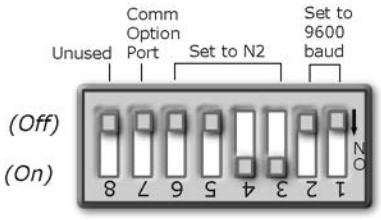
4 Set **SW3** Comm Selector DIP switches **DS3** through **DS6** for N2. See example below.

5 Leave **DS7** and **DS8** in the OFF position. These switches are not applicable to N2.

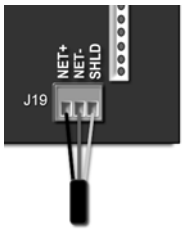
SW3 Protocol Switch Settings for N2

DS8	DS7	DS6	DS5	DS4	DS3
Off	Off	Off	Off	On	On

The following example shows the DIP switches set for 9600 baud and N2.



6 Connect the N2 EIA-485 network to the controller's **J19** port. Connect to **Net+**, **Net-**, and **SHLD**.



Wire specifications

- A dedicated 22 AWG shielded twisted pair wire (EIA 485)
- Maximum wire length 2000 feet (610 meters) or 32 nodes
- Devices should be daisy-chained and not star-wired
- Attach the drain/shield wire to both ends of the network segment and through every controller

NOTE Use the same polarity throughout the network segment.

7 Turn **on** the WSHP Open's power.

Troubleshooting N2

Check the following to troubleshoot your WSHP Open:

1 Verify that the BAS and controller are both set to speak N2 protocol on the Comm Selector DIP switches **DS3 - DS6**.

2 Verify that the BAS and the controller are both set for the same baud rate:

- 9600 for N2
- Baud rate DIP switches DS2 and DS1
- Obtain a Modstat of the controller. Scroll to the bottom of the page to **Network Communications** to view the active protocol and baud rate.

3 Verify that the BAS is configured to speak 2-wire EIA-485 to the controller. The BAS may have to configure jumper or DIP switches on their end.

4 Verify that the BAS and the controller have the same communication settings (8 data bits, No Parity, and 1 stop bit).

5 Verify proper connection wiring between the BAS and the controller.

6 Verify that the rotary address switches are set for the controller's unique slave address.

7 BAS must be reading or writing to the proper point addresses on the controller.

8 BAS is sending requests to the proper slave address of the controller.

NOTES

- Refer to Appendix A for the Network Points list.
- Refer to *Appendix D* (page 42) for the Protocol Implementation Conformance Statement.

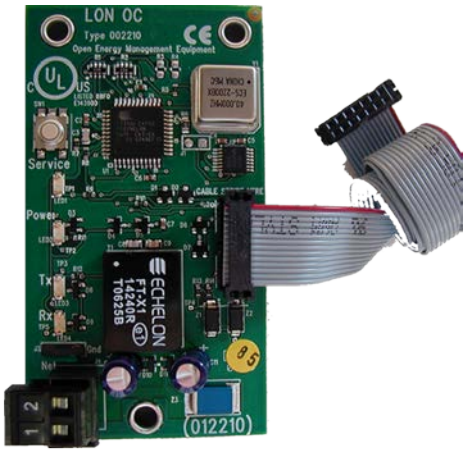
LonWorks

WARNING!

When you handle the LonWorks Option Card:

- Do not contaminate the printed circuit board with fingerprints, moisture, or any foreign material.
- Do not touch components or leads.
- Handle the board by its edges.
- Isolate from high voltage or electrostatic discharge.
- Ensure that you are properly grounded.

Refer to *Appendix E* (page 44) for the LonWorks Protocol Implementation Conformance Statement (PICS).



To set up the WSHP Open for the LonWorks Option Card (Part #LON-OC)

1 Turn **off** the WSHP Open's power.

NOTES

- Changes made to the switches when the controller is on will not take effect until the power has been cycled!
- The controller's rotary address switches are not used when the LON-OC is installed. That's because each LON-OC has a 48-bit Neuron ID that makes it unique on the LonWorks network.

2 Set the Comm Selector DIP switches **DS1** and **DS2** on **SW3** for 38.4k Communications speed. This is the speed at which the LON-OC speaks to the WSHP Open. It is fixed at 38.4k.

3 Set the Comm Selector DIP switches **DS3** through **DS6** on **SW3** for LonWorks. See example below.

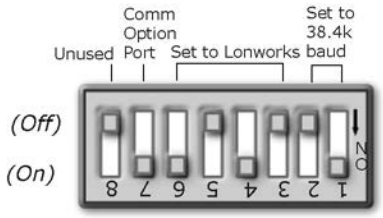
4 Set the Comm Selector DIP switch **DS7** on **SW3** to the ON position to enable the LON-OC.

5 Leave Comm Selector DIP switch **DS8** on **SW3** in the OFF position since it is not used.

SW3 Protocol Switch Settings for LonWorks

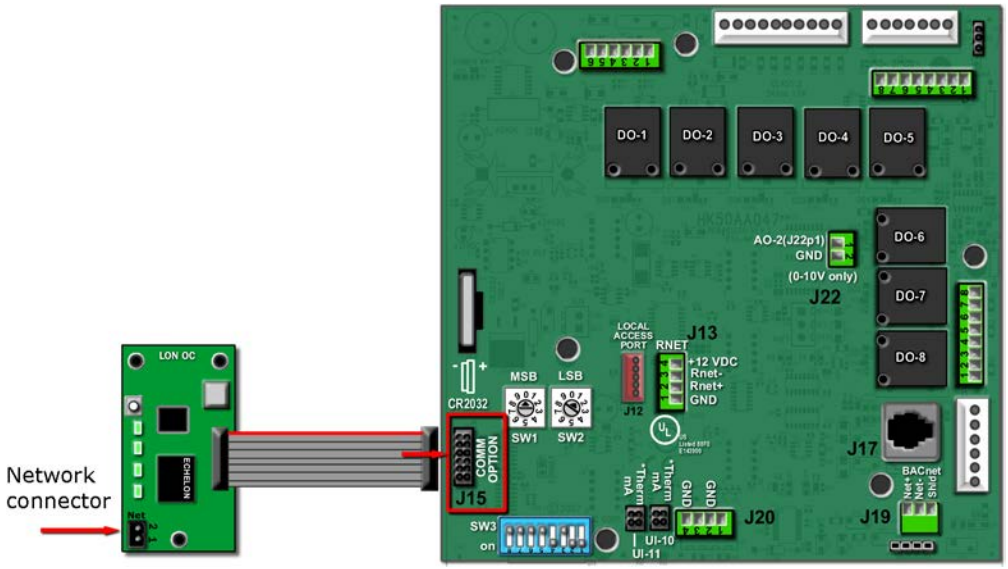
DS8	DS7	DS6	DS5	DS4	DS3
Off	On	On	Off	On	Off

The following example shows the DIP switches set for 38.4k baud and the LON-OC enabled.



6 Plug the LON-OC's ribbon cable into Comm Option Port **J15** on the controller. See illustration below.

CAUTION! The controller must be **OFF** before being connected.



7 Connect the LonWorks network to the LON-OC via the 2-pin **Net** port.

NOTE The 2-pin **Net** port provides TP/FT-10 channel compatibility. The TP/FT-10 or "Free Topology" network type is **polarity insensitive**. Use 24 to 16 AWG twisted pair wire.

8 Turn **on** the WSHP Open's power.

9 Commission the controller for LonWorks communication. See instructions below.

Commissioning the controller for LonWorks communication

Before a device can communicate on a LonWorks network, it must be commissioned. Commissioning allows the system integrator to associate the device hardware with the LonWorks system's network layout diagram. This is done using the device's unique Neuron ID.

A network management tool such as Echelon's LonMaker is used to commission each device, as well as to assign addressing. Specific instructions regarding the commissioning of LonWorks devices should be obtained from documentation supplied with the LonWorks Network Management Tool.

When a new device is first commissioned onto the LonWorks network, the system integrator must upload the device's External Interface File (XIF) information. LonWorks uses the XIF to determine the points (network variables) that are available from a device. The WSHP Open has a set of predefined network variables. These variables can be bound or accessed by the network management tool.

NOTE Contact your local Carrier representative for a copy of the .XIF file.

The **Browse** feature of the Network Management Tool allows you to read real-time values from the WSHP Open. The Network Management Tool allows you to test integration prior to binding the controller's network variables to other LonWorks nodes.

Troubleshooting LonWorks

Check the following to troubleshoot your WSHP Open:

1. Verify that the BAS and controller are both set to speak the LonWorks protocol by theComm Selector DIP switches **DS3 - DS6**.
2. Verify that the BAS and the controller are both set for the same baud rate:
   - 38.4k for LonWorks
   - Baud rate DIP switches DS2 and DS1
   - Obtain a Modstat of the controller. Scroll to the bottom of the page to **Network Communications** to view the active protocol and baud rate.
3. BAS must be reading or writing to the proper point addresses on the controller.
4. Verify that the Comm Option Port is enabled on the controller. The Comm Option Port setting must be set via **SW3** (switch **DS7**). It should be in the ON position to enable LonWorks communication.
5. Verify that controller has been properly commissioned onto the LonWorks network. Commissioning is done with a network management tool such as LonMaker and allows the system integrator to associate the controller with the LonWorks system's network layout diagram. This is done using the controller's unique Neuron ID. The Network Management Tool is also used to upload the controller's .XIF file to determine the network variables that reside inside of the controller.
6. Use the **Browse** feature of the Network Management Tool to verify that you can communicate and get real-time values from the controller before connecting the BAS.
7. Once you have confirmed communications with the controller using the Network Management Tool, connect the BAS.
8. Verify that the BAS is connected properly to the LON-OC's 2-wire TP/FT-10 Net port. The LON-OC's TP/FT-10 port is polarity insensitive. The BAS may have to configure jumper or DIP switches on their end to support TP/FT-10.

Start-up

To start up the WSHP Open, you need one of the following user interfaces to the controller. These items let you access the controller information, read sensor values, and test the controller.

This Interface...	Provides a...
Field Assistant application - Runs on a laptop that connects to controller's Local Access port [1]	Temporary interface
Equipment Touch device - Connects to controller's Rnet port [2]	Temporary or permanent interface
i-Vu® application Available for BACnet systems only	Permanent interface
System Touch device Available for BACnet systems only Wire to an MS/TP network connector and a 24 Vac power supply [3]	Temporary or permanent interface

[1] Requires a USB Link (Part #USB-L).

[2] See the *Equipment Touch Installation and Setup Guide* for detailed instructions.

[3] See the *System Touch Installation and Setup Guide* for detailed instructions.

Sequence of Operation

The multi-protocol WSHP Open controls mechanical cooling, heating, and waterside economizer outputs, based on its own space temperature input and setpoints. An optional CO_2 IAQ (Indoor Air Quality) sensor that is mounted in the space maximizes the occupant's comfort. The WSHP Open has its own hardware clock that is automatically set when you download the heat pump software to the board.

See *Scheduling* (page 20) for occupancy types.

The following sections describe the multi-protocol controller's functions. All point objects mentioned in this sequence of operation reference the touchscreen interface. Points in Field Assistant and the i-Vu® application are the same or similar.

Scheduling

Scheduling - You must configure time periods to schedule the transitions from occupied to unoccupied operation. The time periods control the space temperature to occupied heating and cooling setpoints. The WSHP Open operates continuously in the **Occupied** mode until you configure either a time schedule or a third party control system **Enables/Disables** the **BAS On/Off** point. You must set your local time and date for these functions to operate properly.

You can change the occupancy source to one of the following:

Occupancy Schedules - The controller is occupied 24/7 until you configure a time schedule using either the Equipment Touch, Field Assistant, the i-Vu® application, or a third party **Enables/Disables** the **BAS On/Off** point. You can disable this by going to **Configuration** > **Unit Configuration** > **Occupancy Schedules**, changing the point from **Enable** to **Disable** and clicking **OK**.

NOTE You must **Enable** this point in order for the Equipment Touch, Field Assistant, or the i-Vu® application to assign a time schedule to the controller.

Schedule_Schedule - The unit operates according to the schedule configured and stored in the unit. The schedule is accessible via the Equipment Touch, the i-Vu® application, or Field Assistant. The daily schedule consists of a start and stop time (standard or 24-hour mode) and 7 days of the week, starting with Monday and ending on Sunday.

CAUTION Scheduling can only be controlled from one source.

Occupancy Input Contact (Option) - If configured for remote occupancy control (default), the WSHP Open can use an external dry contact closure to determine the occupancy status of the unit. You must disable the **Occupancy Schedules** in order to use the occupancy contact input. The unit enters an occupied mode when it senses the abnormal input. After the input returns to its normal state, the unit stays in the occupied mode for the configured **Occ Override Delay** period (15 minutes default).

BAS (Building Automation System) On/Off - For use with a Building Automation System that supports network scheduling, you must disable the **Occupancy Schedules** so the BAS system can control the unit through a network communication and the BAS scheduling function.

Global Occupancy Scheduling - The WSHP Open can read the occupancy status from another unit so that a group of WSHP's can be controlled from a single occupancy schedule. The local **Occupancy Schedules** must be disabled in order to use the global occupancy input.

BACnet Network Occupancy Input - The WSHP Open can accept an external BACnet Binary Network Input for occupancy control. This function is only compatible with units used in BACnet systems. You need to configure the System Occupancy BACnet network input point to locate the device and point name where the external occupancy point information resides. You must also disable **Occupancy Schedules** in order to use this input.

Fire/Smoke detector input

The WSHP Open can read the status of a normally closed FSD contact input to determine if a fire or smoke detector alarm is present. If the controller determines an alarm condition is present, all heating, cooling, and the fan are disabled. The switch is factory-set to **Normally Closed** and cannot be changed.

Shutdown input

The WSHP Open controller has a shutdown input (software point) which, when set to its **Active** mode causes the WSHP to safely shutdown in a controlled fashion. Heating and cooling is disabled after any minimum runtime conditions expire and the fan is disabled after the fan-off timer expires. All alarms are reset but any active alarm remains active. After the shutdown input transitions from **Active** mode to **Inactive**, the WSHP Open restarts after the configured power fail restart delay expires.

Indoor fan

You can configure the indoor fan to operate in any one of 3 **Fan Modes**:

- **Auto** - intermittent operation during both occupied and unoccupied periods
- **Continuous** (default) - intermittent operation during unoccupied periods and continuous during occupied periods
- **Always on** - operates the fan continuously during both occupied and unoccupied periods

In the **Continuous** default mode, the fan is turned on when any one of the following is true:

- It is in occupied mode, which is determined by the occupancy status
- There is a demand for cooling or heating in the unoccupied mode
- There is a call for dehumidification (optional)

When power is reapplied after a power outage, there is a configurable delay of 5 - 600 seconds (default 60) before starting the fan. You must configure the fan delay:

- The **Fan On Delay** defines the delay time (0 - 30 seconds, default 10) before the fan begins to operate after heating or cooling is started.
- The **Fan Off Delay** defines the delay time (0 - 180 seconds, default 45) the fan continues to operate after heating or cooling is stopped.

NOTE The fan continues to run as long as the compressors, heating stages, or the dehumidification relays are on. If the SPT failure alarm, ZS Sensor failure alarm, or condensate overflow alarm is active, the fan is shutdown immediately, regardless of occupancy state or demand.

Automatic Fan Speed Control - The WSHP Open can control up to 3 fan speeds using the ECM (Electronically Commutated Motor). The motor operates at the lowest speed possible to provide quiet and efficient fan operation with the best latent capability. The motor increases speed if additional cooling or heating is required to reach the desired space temperature setpoint. The control increases the motor's speed as the space temperature rises above the cooling or below the heating setpoint. The amount of space temperature increase above or below the setpoint required to increase the fan speed is configurable in the setpoint. Also, the control increases the fan speed as the **Supply Air Temperature** approaches the configured minimum or maximum limits.