
# Modular Chilled Water & Heat Pump Systems

Greg Drensky
Vice President

# Who is Jacco

- Established 1968
  - Hudson, Ohio
  - Columbus, Ohio
  - Toledo, Ohio

- Focused on the Engineered Environment

- Systems Knowledgeable
  - HVAC Systems
  - Service & Maintenance
  - Parts


JACCO

# Purpose Statement

The purpose of our Company is to solve our customers problems, in the most economical way, at all times optimizing the owning experience.


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# Who is Jacco

- Operations
  - –Brenda Homjak
  - –Mike Spangler
  - –Chad Russell
  - –Mike Mueller
- Contractor Owning Experience
  - –Dan Duignan
  - –Rick Baker
- Engineering Owning Experience
  - –Greg Drensky
  - –Jerry Cohen
- Owning Experience
  - –Beth Plazak
  - –Jeff Watson

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# Who is Jacco

- 30 Minute Pledge
  - Design
  - Questions
  - Problems
  - Answers


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# Upcoming Seminars:

- June 13th: Best Practices For DX Piping
- September 12th: Applying Adiabatic and Steam Humidification Systems
- December 12th: Applying Low Dewpoint OA Systems Using DX and Desiccant Technology

# Why Use Modular Chillers:

- Space
  - System Replacement
  - Additional Tenant Space
- Sound
- Redundancy
- Future Expansion
- Simultaneous Heating & Cooling
- Rigging
- Accessibility

ROBUR®
caring for the environment

SAMSUNG

WaterFurnace®
Smarter from the Ground Up™

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# Natural Gas Fired

ROBUR®

caring for the environment

# Why Use Natural Gas Modular Chillers:

- Consistent Excessive Electrical Power
- Peak Demands
- Single Phase Only Available
- Local Natural Gas Wells
- Low Environmental Impact
- Emergency Power Backup

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Founded in 1956

ROBUR®

caring for the environment

Corporate Headquarters:
Italy 300,000 sq.ft

Sales & Service location in US:
Evansville, IN – USA

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# Absorption Products History


1902-1953


1954-1984


1984-1987


1987-1991


1991-2003


2003-Present

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# Advantages of a Robur System

- Drastic Reduction in Electrical Power Consumption
  - Reduces buildings' HVAC systems' electrical demand by 80% compared to electric cooling & heat pumps
  - Single Phase Power reducing electrical infrastructure and associated costs.
  - No additional building upgrades required.
  - Eliminate or reduce electric demand charges
  - Smaller generator requirements for applications requiring off grid power or emergency cooling


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# Advantages of a Robur System


- Environmentally Friendly
  - No CFC's, HFC's or HCFC's which deplete the Earth's ozone and contribute to Green House Gas elimination.
  - Ozone depletion potential (ODP) = 0
  - Global warming potential (GWP) = 0
  - Very high efficiency recovering thermal energy from the ambient (Heat Pumps)
  - Low Nox emissions – premixed burner
  - Smaller carbon footprint when compared to generating electricity to power traditional electric.

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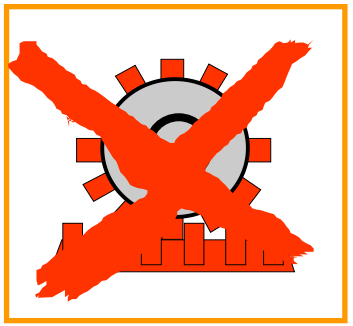
# Advantages of a Robur System

- Reliability / Durability
  - Long Life
  - No compressors or engines
  - No mechanical wear and tear
  - Only 3 moving parts
  - Completely sealed circuit, with no need of periodic refilling of refrigerant fluid
  - No refrigerant leaking
  - Low maintenance required



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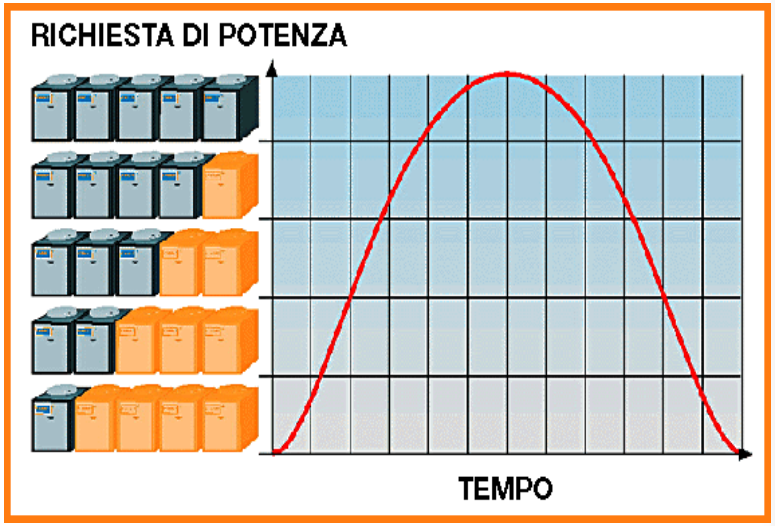
# Advantages of a Robur System




- Modularity / Redundancy
  - Wide range of Systems available
  - Redundancy with modular design
  - Multiple Links available
  - Application Flexibility
  - Staging capability adapts to changing load conditions
  - Only use utilities required to meet building loads

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# Advantages of Robur System

- Lifestyle
  - Heating efficiency up to 129%
  - Operational cost savings
  - Ultra-low noise level
  - Wide range of ambient operating conditions (-20°F to 131°F depending on model)
  - Water temperatures from 14°F to 185°F

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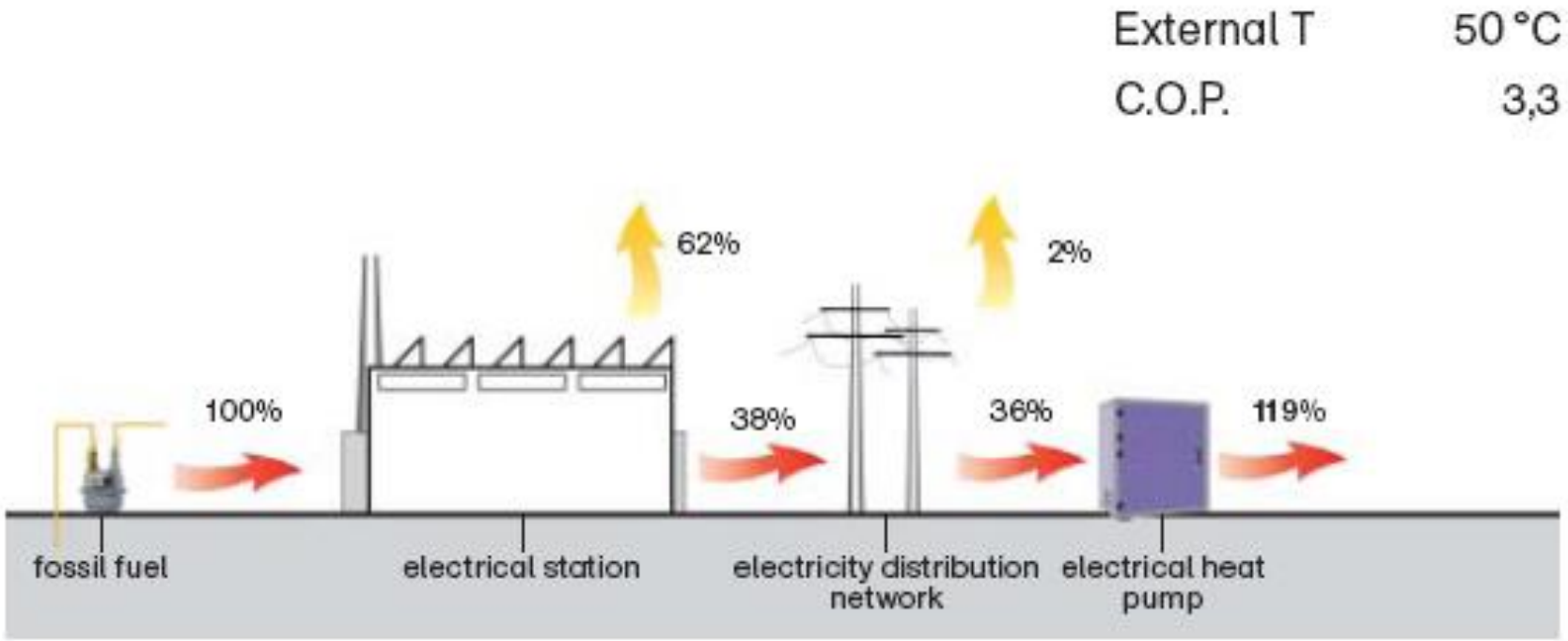
# Electric Heat Pump




Electric heat pump: efficiency-primary energy ratio.

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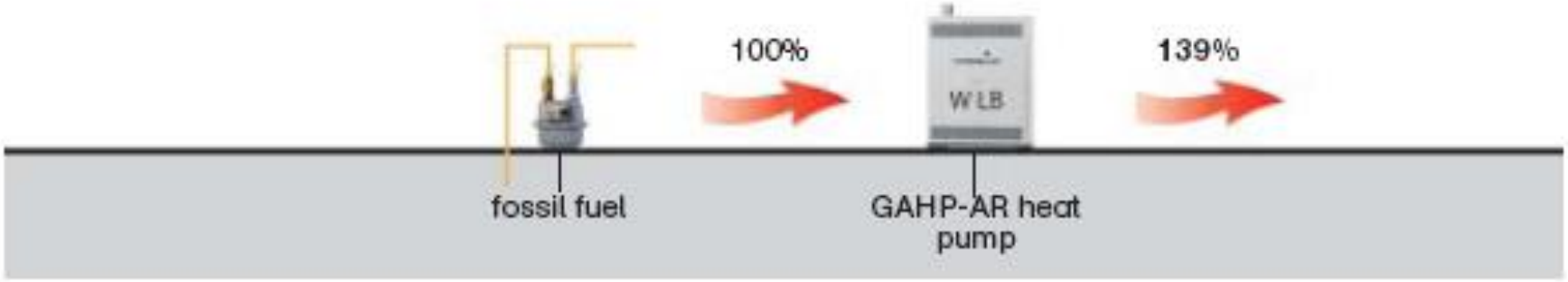
# GAHP-W LB

| | |
|---|---|
| External T | 50 °C |
| G.U.E. | 139% |




GAHP-W LB heat pump: efficiency-primary energy ratio.

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# Gas Fired Product Line

- HEAT PUMPS
- CHILLERS
- CHILLER-HEATERS
- MODULAR HEATING & COOLING LINKS




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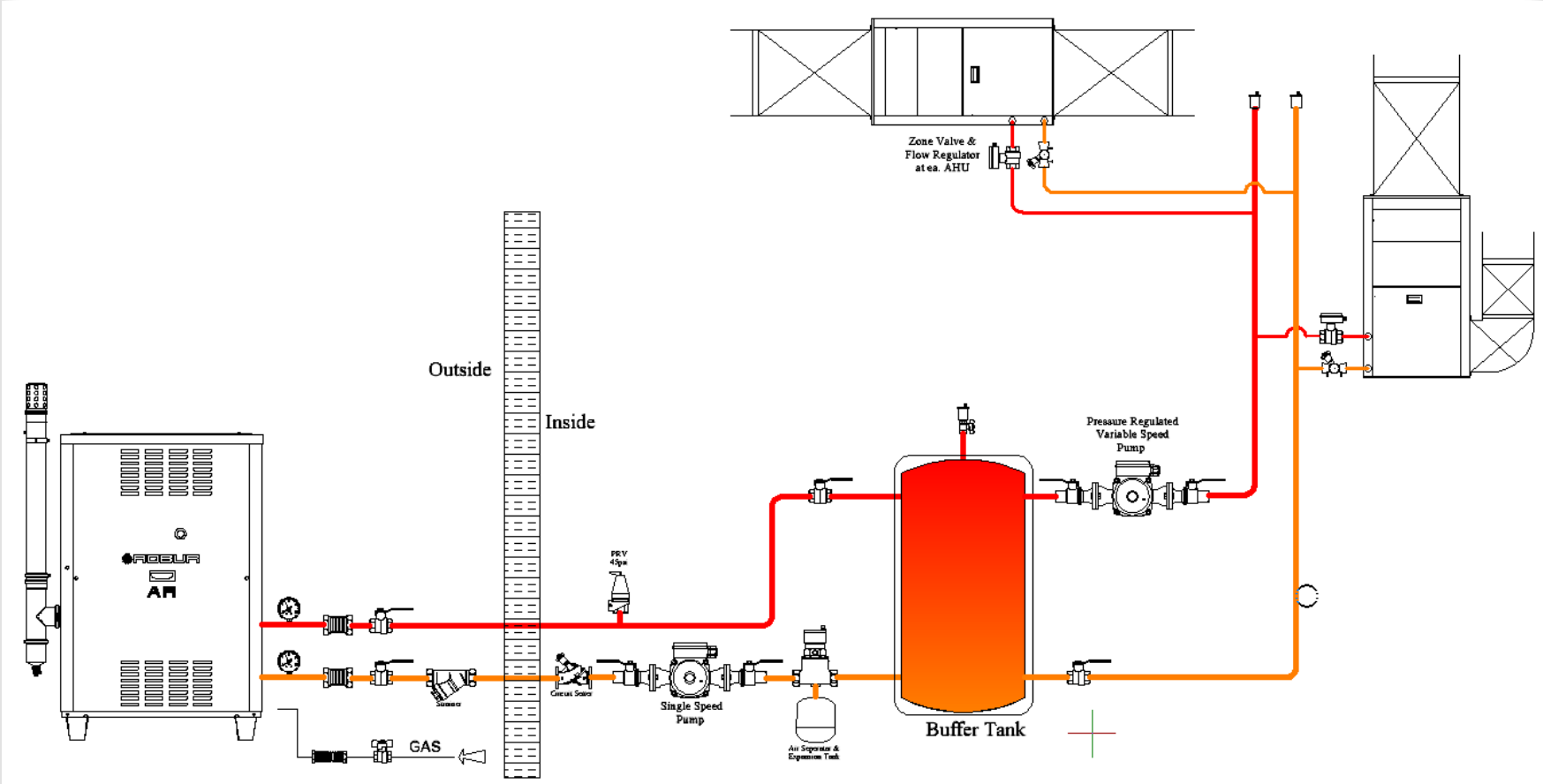
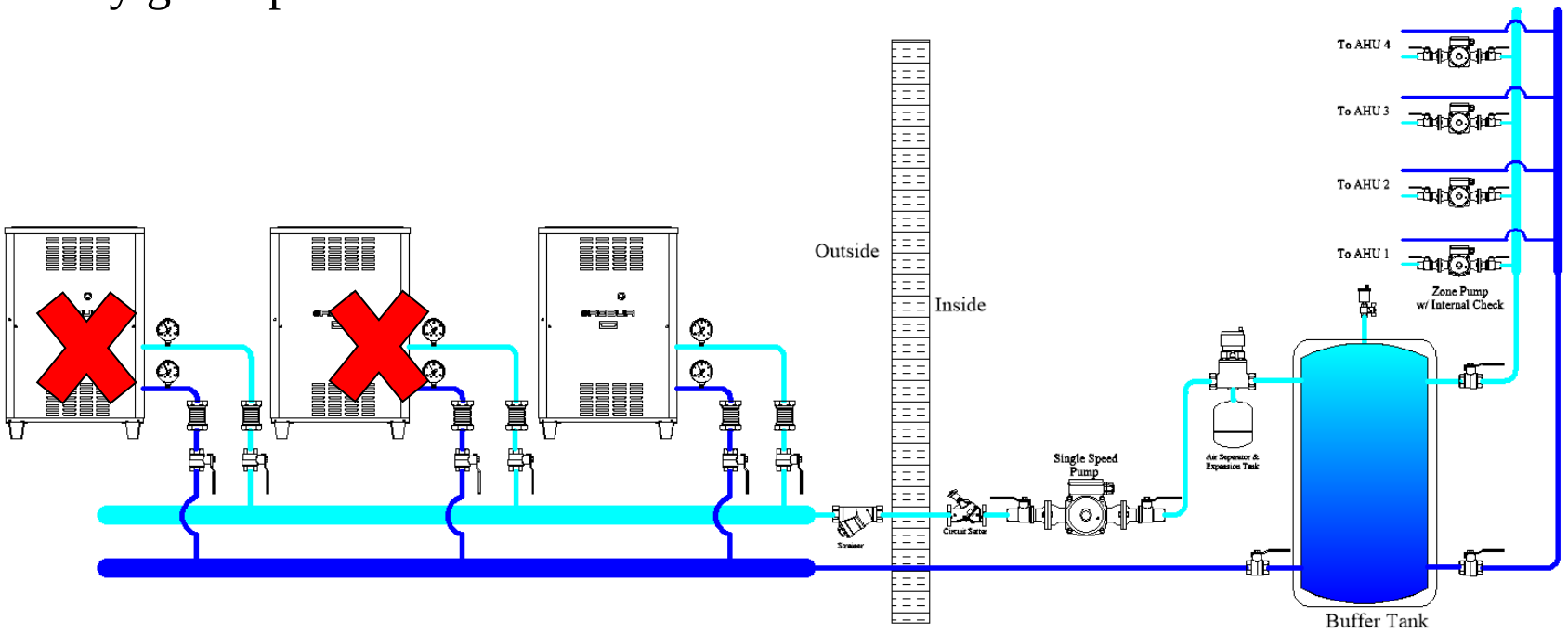
# Each module is capable of singular / independent operation – Providing Chilled and/or Hot water for various application types



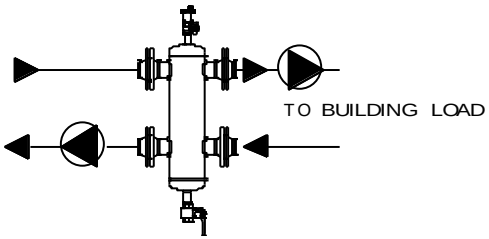
•More Commonly, These units are installed as a modular system utilizing multiple units – Allowing operation at larger capacities as well as modularity and redundancy

•The modular configuration allows system scaling to meet application capacity as necessary with no down time and only using the energy required at any given period.



# Factory built Modular “Links”

- Provided with single point water, gas, and electrical connections
- Up to 6 Modules per “Link”
- Customizable/ built to order
- Available in 2, 4 or 6-Pipe configurations
- Mix and Match Module types to provide a complete system capable of providing Heating, Cooling, DHW, Reheat and more.....
- Manifold multiple links for even larger capacities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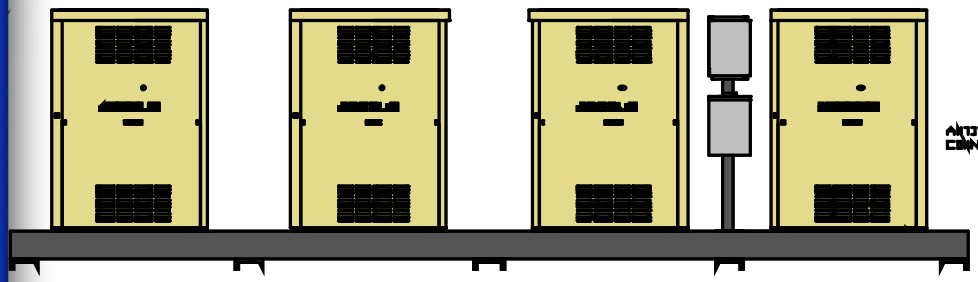
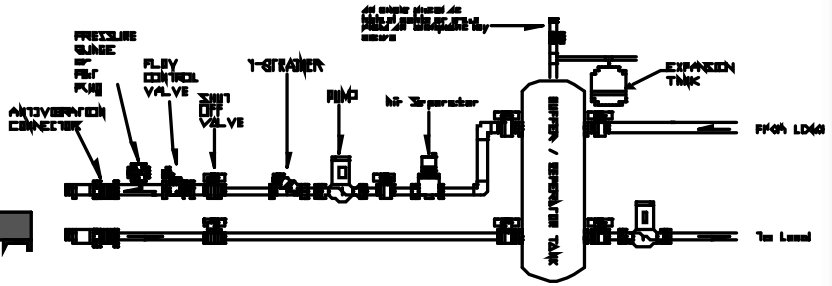
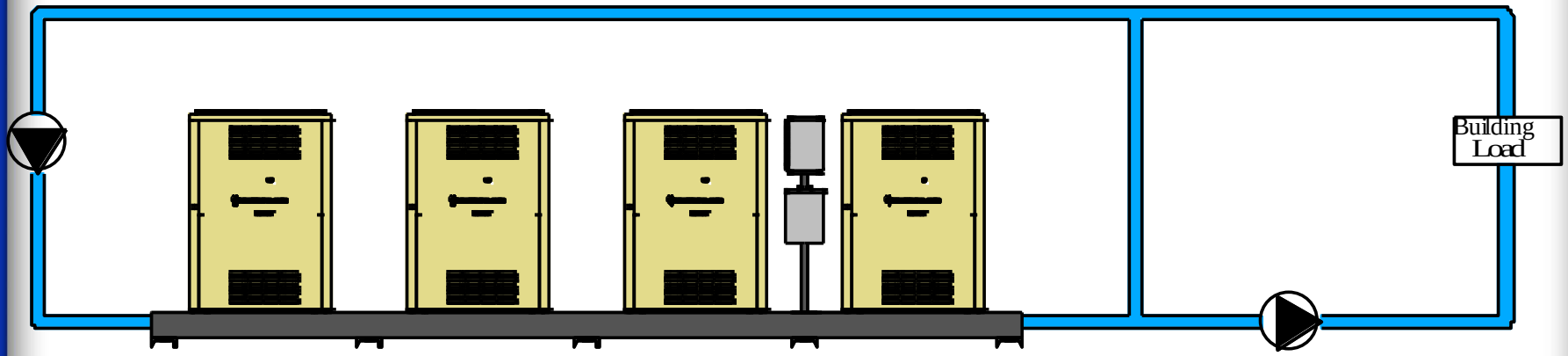
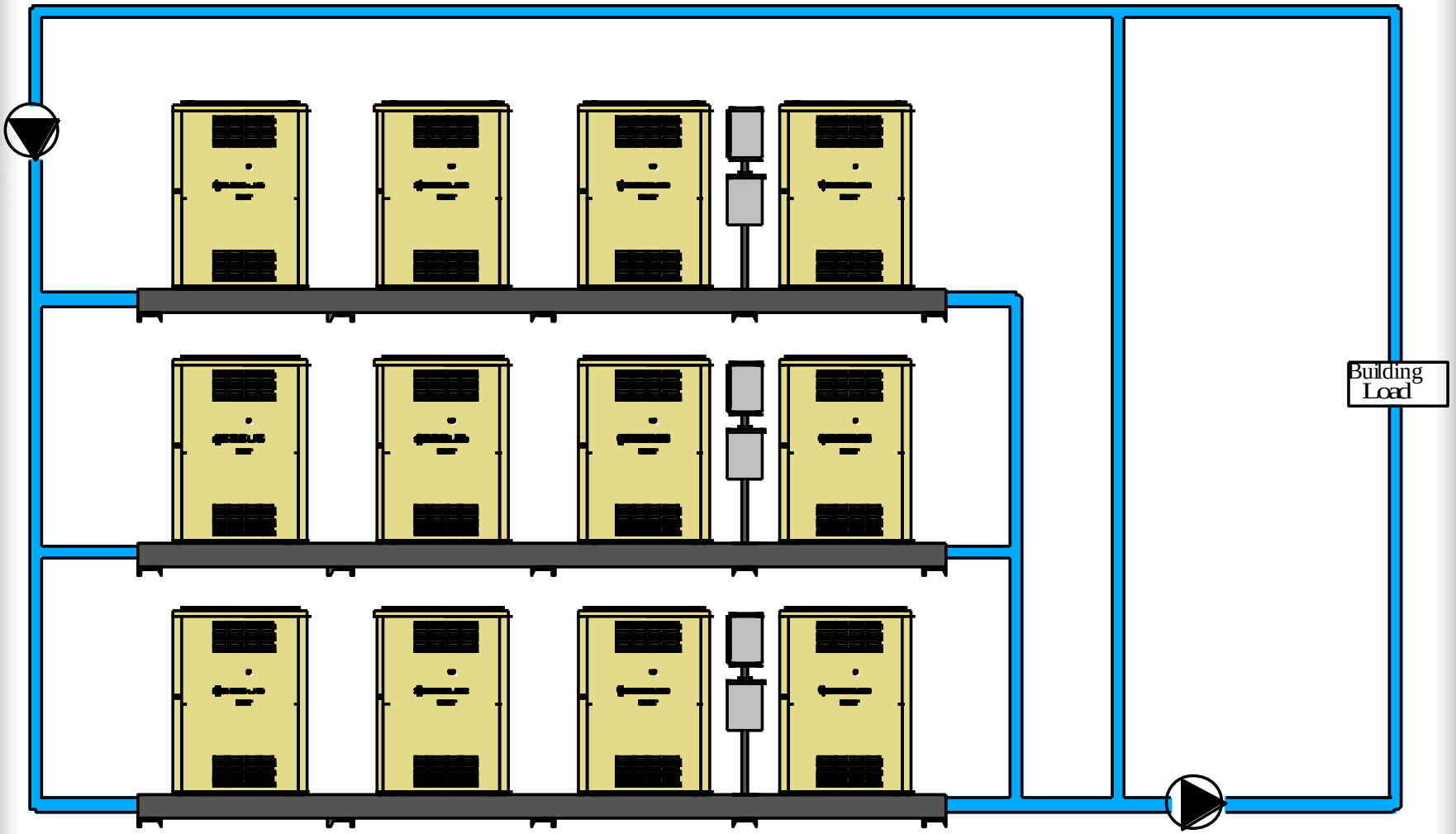
# Application





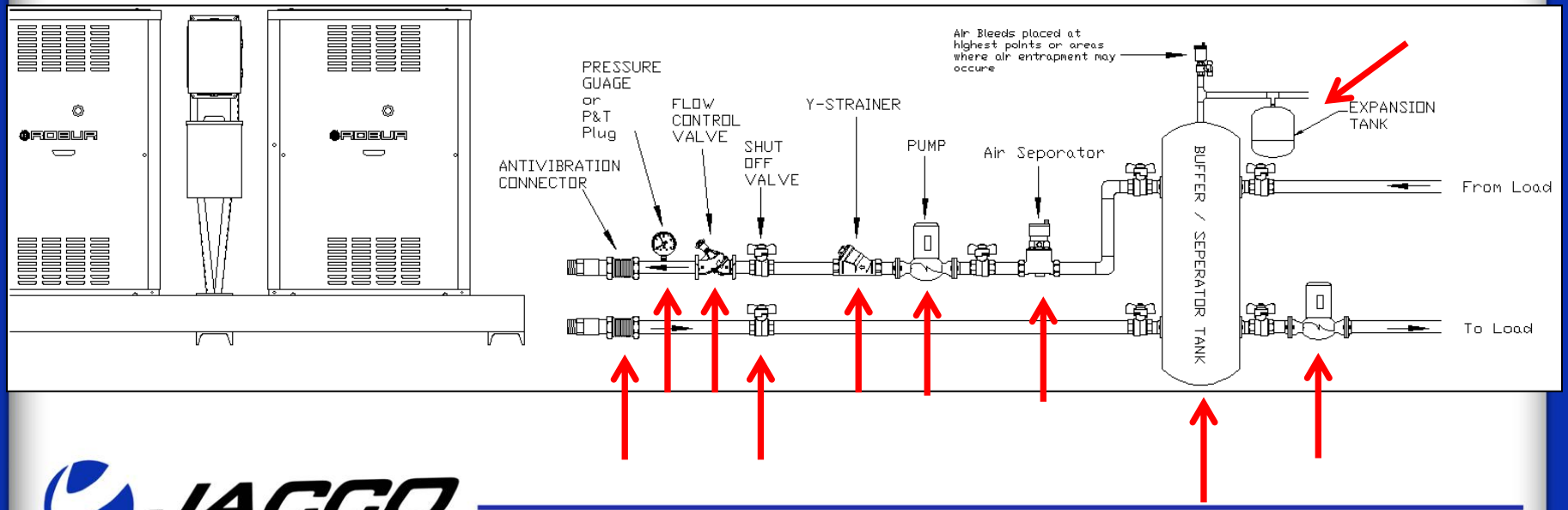
# Application



# Installation

**Necessary / Recommended Hydronic components:**

- Anti-Vibration / Flexible Connectors
- Pressure Guage / PT Fittings
- Flow Control Valve / Curcuit Setter
- Isolation / Shut Off Valves – Full Flow
- Water Strainer / Filter
- Water Pump(s)
- Air Seporator / Air Bleeds
- Expansion Tank
- Buffer Tank
- Load By-Pass Valves – Not Shown
- 45 psi High Pressure relief valve to be installed on hot water systems – not to exceed 45 psi

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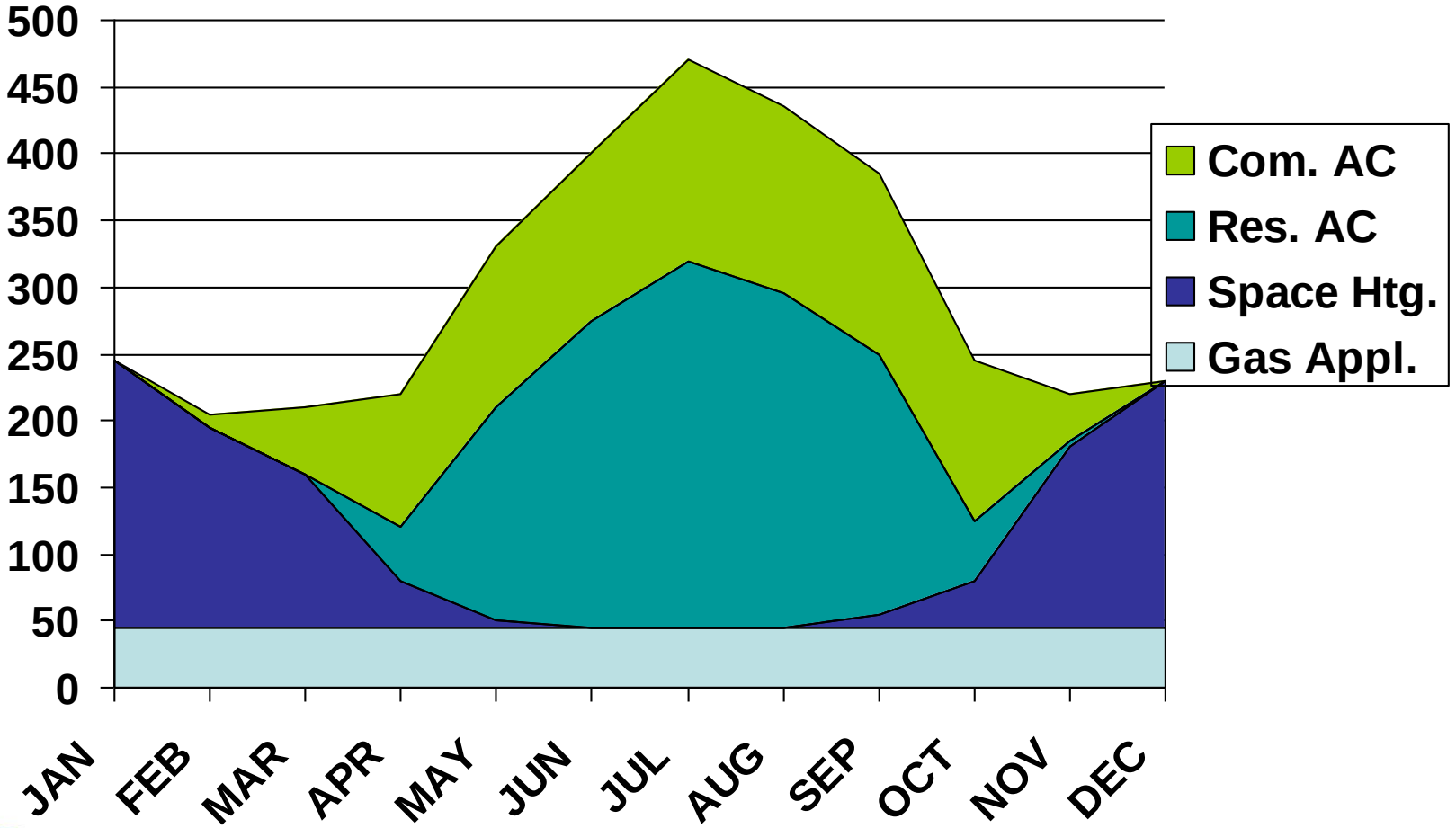
# Natural Gas Fired Chillers

# ANNUAL LOAD PROFILE

## Based On 1200 Cooling Hours

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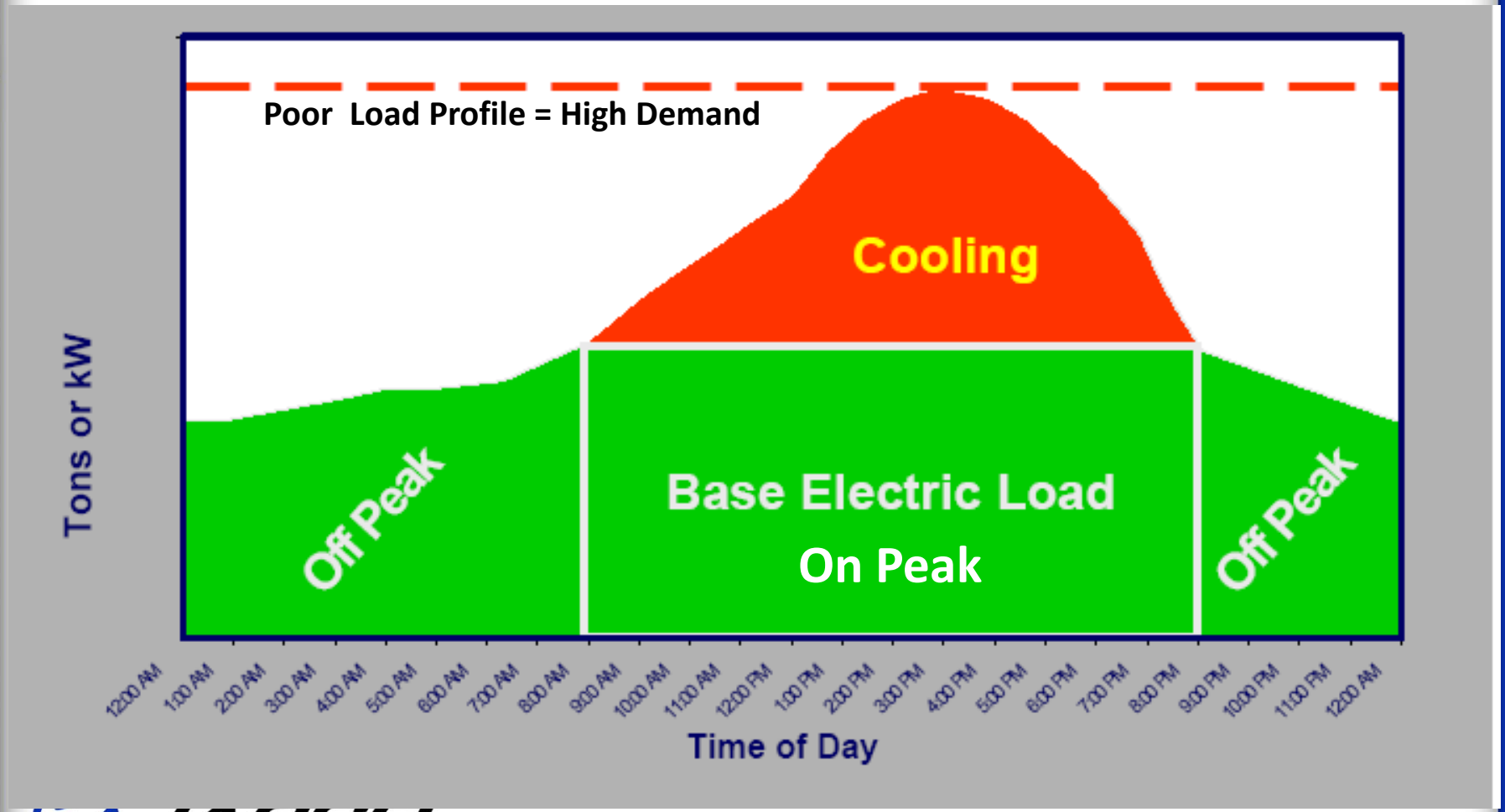
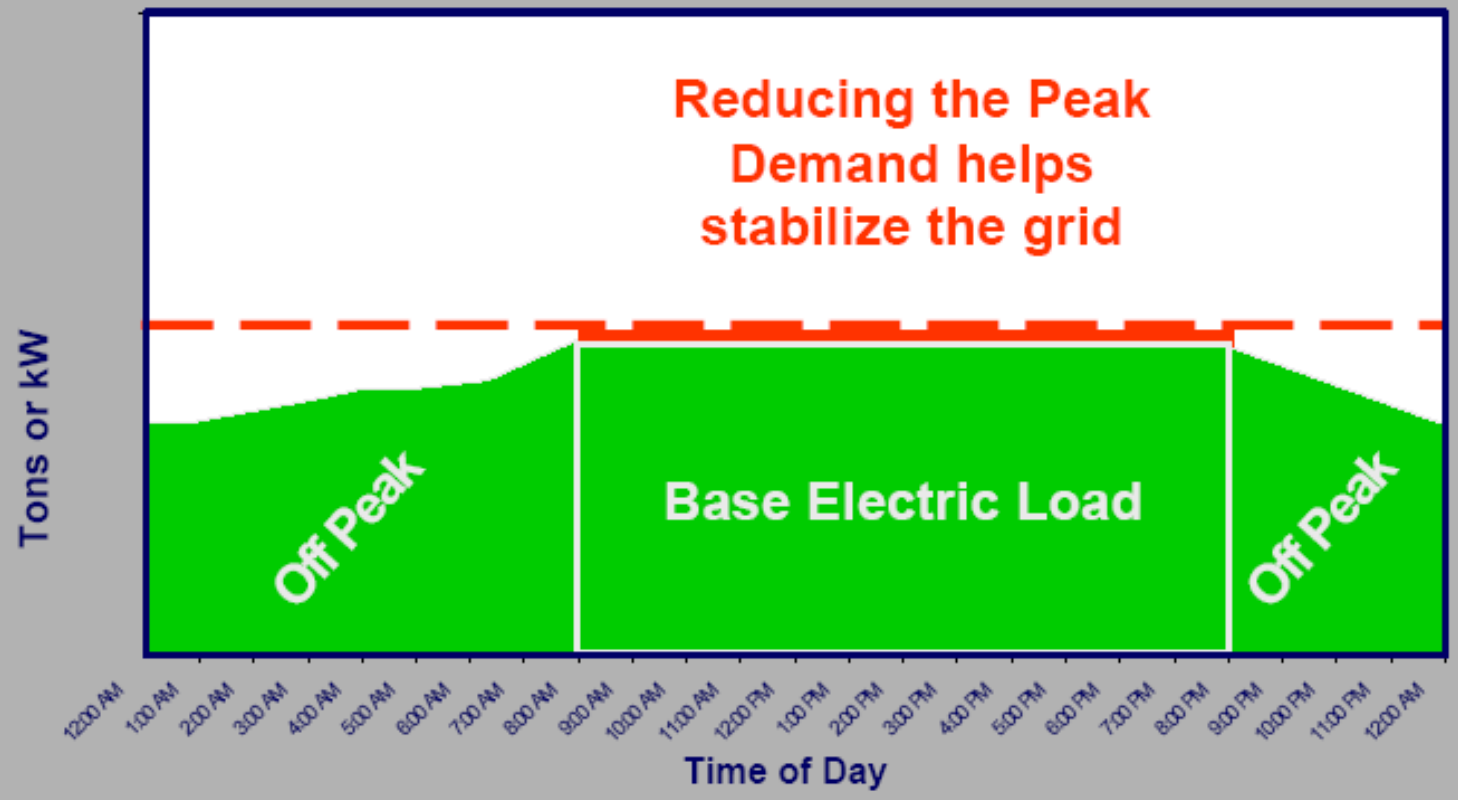
# Typical Facility Load Profile
# Cooling Vs. Base Load



# New Electric Load Profile as a result of Gas Air Conditioning




**During summer, electric usage peaks as natural gas demand drops to its lowest point annually.**

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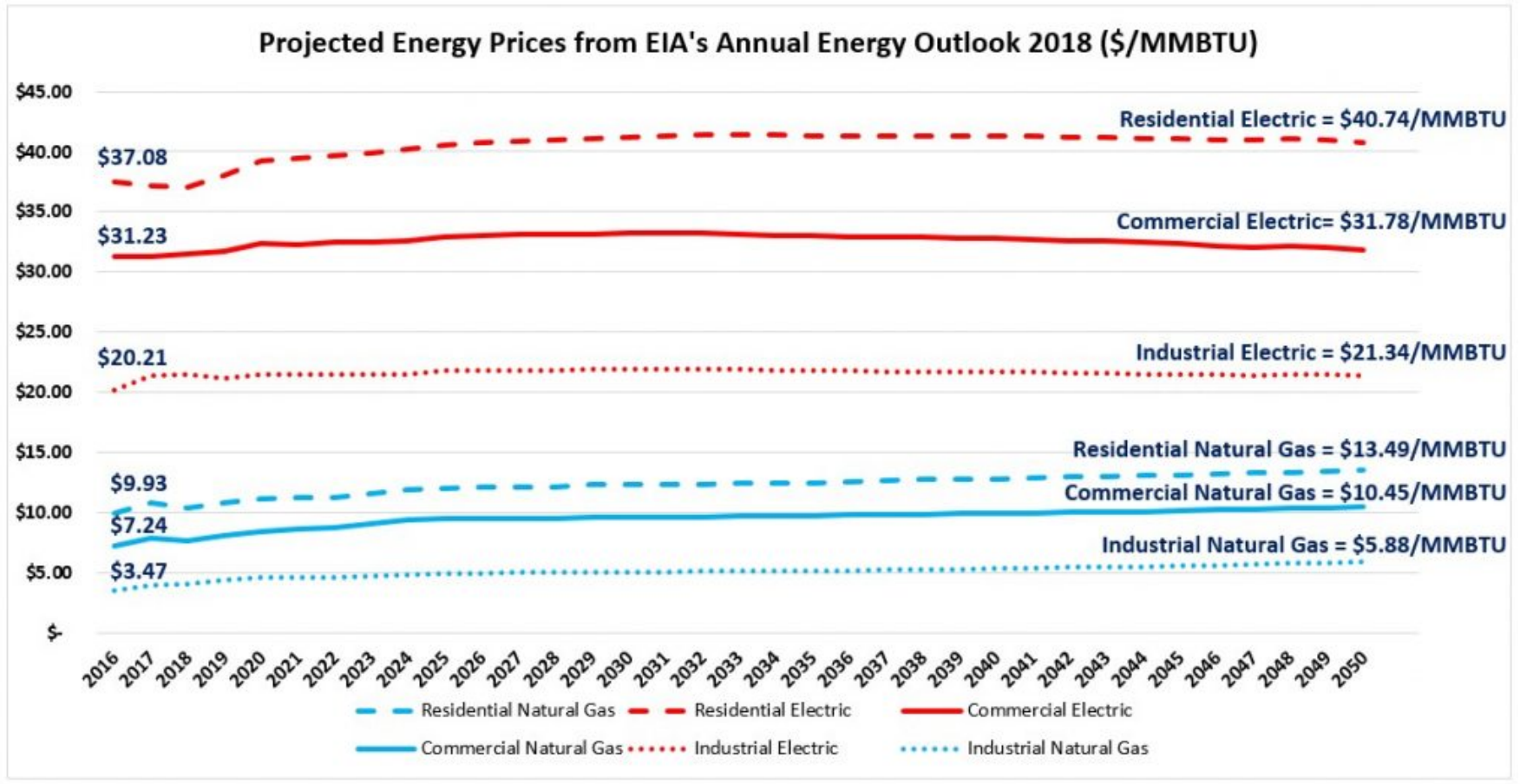
Projected Energy Prices from EIA's Annual Energy Outlook 2018 ($/MMBTU)
$45.00
$40.00
$35.00
$30.00
$25.00
$20.00
$15.00
$10.00
$5.00
$-
$37.08
$31.23
$20.21
$9.93
$7.24
$3.47
Residential Electric = $40.74/MMBTU
Commercial Electric= $31.78/MMBTU
Industrial Electric = $21.34/MMBTU
Residential Natural Gas = $13.49/MMBTU
Commercial Natural Gas = $10.45/MMBTU
Industrial Natural Gas = $5.88/MMBTU
2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050
Residential Natural Gas
Residential Electric
Commercial Electric
Commercial Natural Gas
Industrial Electric
Industrial Natural Gas

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# Cooling Applications

- Comfort Cooling
- Chilled Beams
- Fan Coils
- Air Handlers
- Dehumidification
- Controlled Temperature Rooms
- Equipment Cooling
- Process Cooling
- Medium Temperature Refrigeration (LB Unit)
- Free Supplemental Domestic Hot Water (HR Unit)
- Low Ambient Temperature Operation – Down to 10.4°F (TK Unit)
- High Ambient Temperature Operation – Up to 131°F (HT Unit)

Public Administration
Light Commercial
Offices
Hotels
Industries

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# ACF60 Absorption Chiller Series


33.5”W x 48.5”L x 51”H

ACF60 Series Shown

**ST – 5 Tons**. For installation in climates with design temperatures less than 104° F. Chilled water supply temperature down to 38° F.

**TK – 5 Tons.** For Industrial & Commercial applications requiring heavy use on a year round basis. Operates down to 10.4 ° F ambient.

**HT – 5 Tons.** For installation in climates with design temperatures over 104° F. Chilled water supply temperature down to 38° F.

**LB – 4 Tons.** For installations requiring chilled water temperatures from 37° F to 14° F (4 Tons @ 29° F).

**HR – 5 Tons with <u>Heat Recovery.</u>** For any application requiring the use of free supplemental hot water during chiller operation. Chilled water supply temperature down to 38° F and recovered heat capacity of 85,000 Btu/h with hot water up to 180° F

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# GA-ACF

## THERMODYNAMIC OPERATING CYCLE

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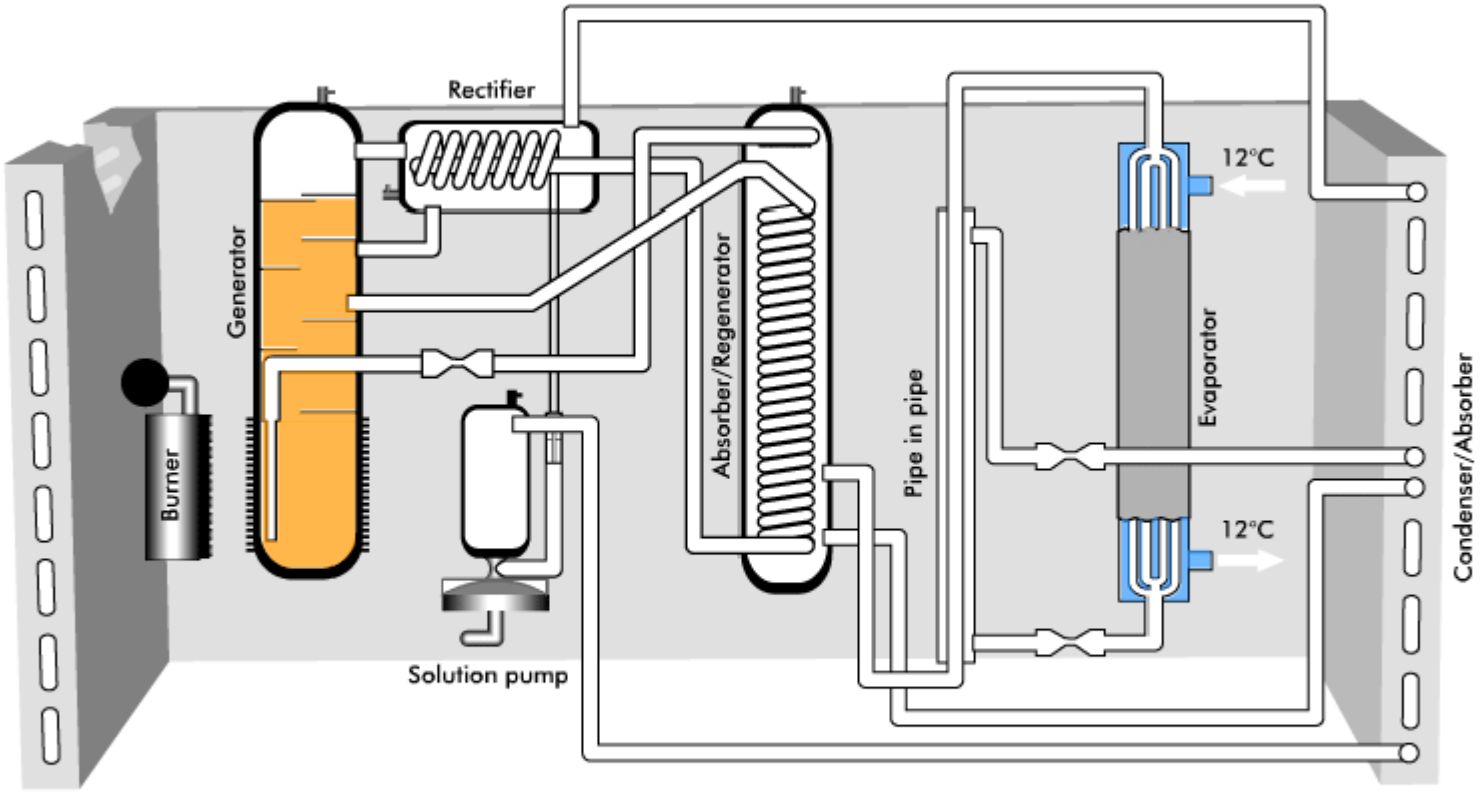


Weak solution

Strong solution

Refrigerant vapour

Refrigerating fluid

Chilled water

# Absorption chiller with Heat Recovery ACF60 - HR


## Performance

During chiller operation (cooling) 86,400 Btu/hr of free hot water can be recovered (hot water outlet temperature up to 176°F).

## Main applications

Hydronic Air Conditioning with Heat Recovery for domestic hot water use or post-heating applications (hotels, restaurants, laundries).

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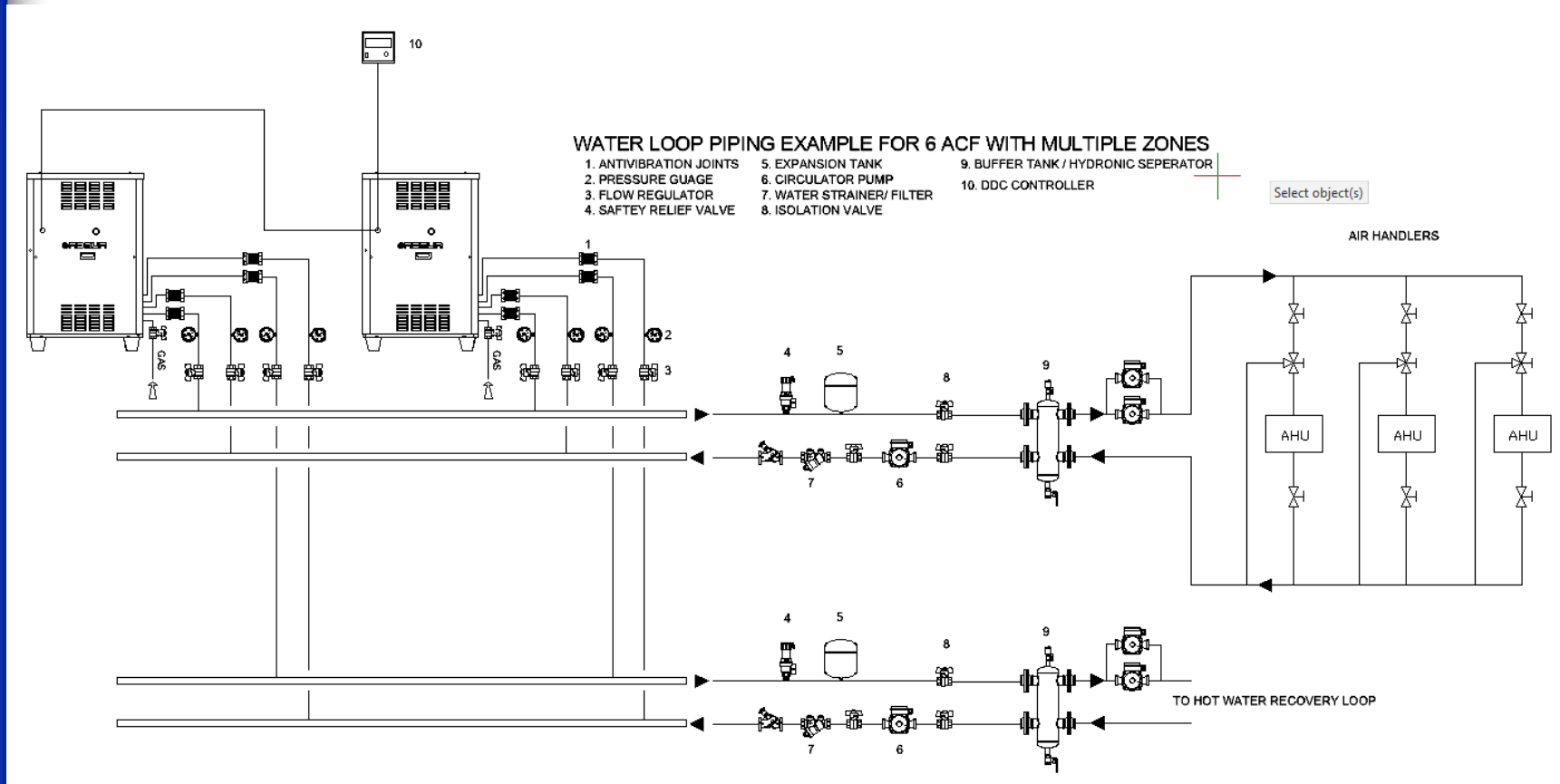
# Application (ACF60-HR)



# Natural Gas Fired Heat Pumps

# GAS ABSORPTION HEAT PUMPS AND RENEWABLE ENERGIES

## ROBUR GAHP

GAHP units put together all the advantages of the two most common heating technologies

PLUS


PLUS

**CONDENSING BOILER ADVANTAGES**

- Natural gas fired
- DHW supply
- Only 1/10 of electricity consumption in comparison to electrical heat pumps

**ELECTRIC HEAT PUMP ADVANTAGES**

- Use of renewable energies
- Cooling supply
- No need of mechanical room

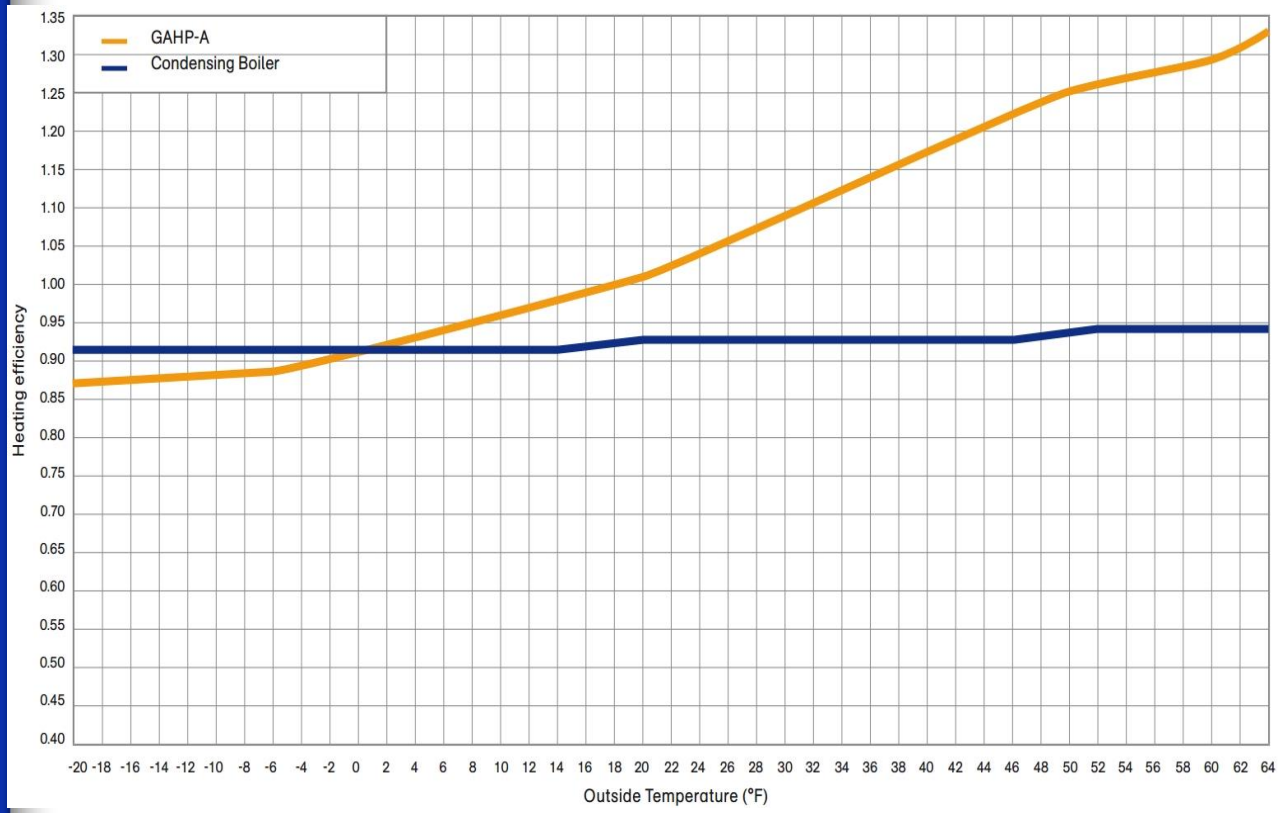
**CONDENSING BOILER MINUS**

- No renewable energy
- Efficiency lower than 100%
- Need for a boiler room

**ELECTRIC HEAT PUMP MINUS**

- High electricity consumption
- Use of fluids harmful for the environment
- Low efficiency at low outdoor temperatures

# Robur Heat Pump vs. Condensing Boiler





**CONDENSING BOILER ADVANTAGES**

- Environmentally friendly using natural gas
- DHW supply
- Only 1/10 of electricity consumption in comparison to electrical heat pumps
- ideal integration into existing or new installations
- High Reliability
- Easy Maintenance
- No use of Harmful Refrigerants

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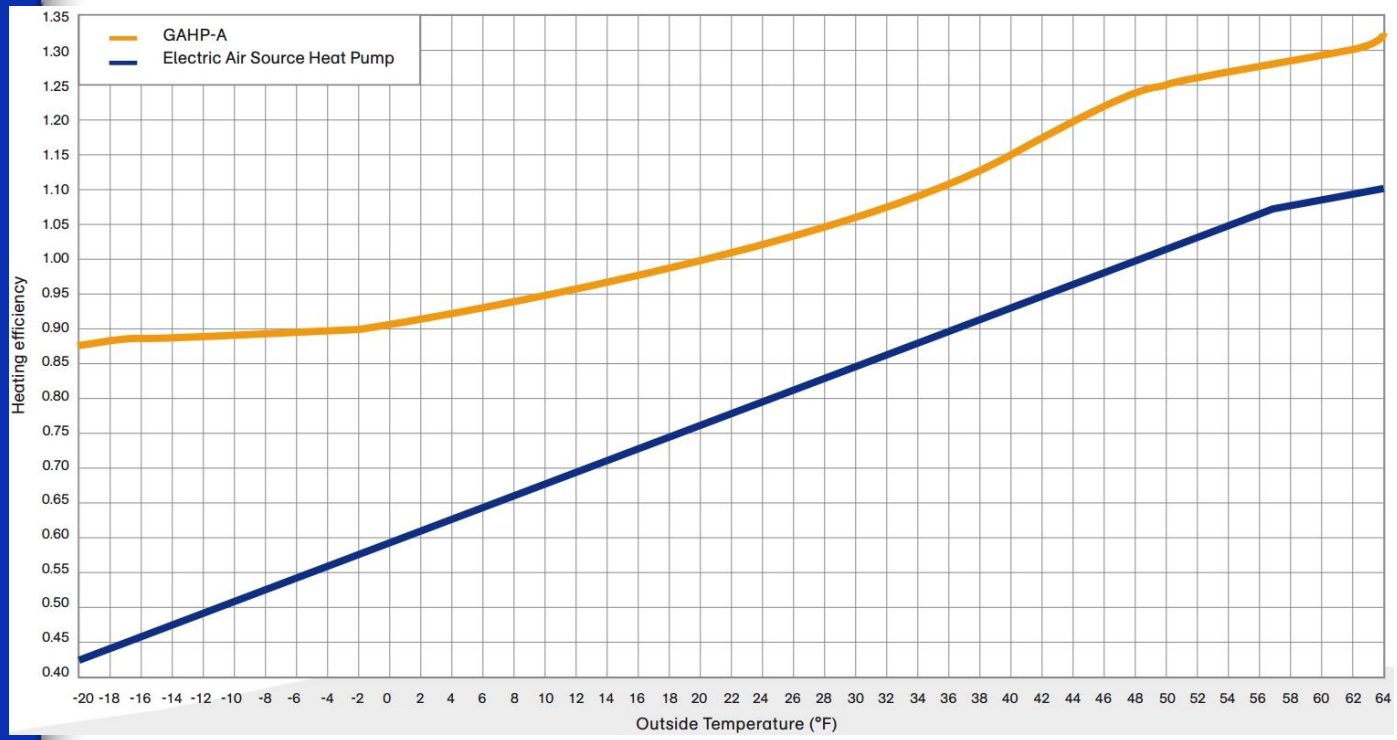
# Robur Heat Pump vs. Electric Heat Pump





**ELECTRIC HEAT PUMP ADVANTAGES**

- Use of renewable energies
- Cooling supply
- No need of mechanical room

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# Heating Applications

- Comfort  Heating
- Radiant Floor Heating
- Fan Coils
- Air Handlers
- Supplemental Domestic Hot Water
- Equipment Heating
- Process Heating
- Supplement Chiller & Boiler Systems

Multi Family Houses

Public Administration
Light Commercial
Offices
Hotels
Industries

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# GAHP Series

## AR, A, W, WLB


33.5”W x 48.5”L x 51”H

## Heat Pump Modules

- Air-Water & Water-Water versions available - Designed for operation in ambient temperatures between -20°F to 120°F (depending on Model)
- Provides Chilled/Hot water temps from 38°F up to 140°F
- Suitable for Commercial, Industrial and Residential Applications
- Models Designed for Comfort and/or Process cooling applications, Comfort Heating, DHW (depending on model type)
- Heating COP range from .85 to 1.46 – Nom. = 1.29 (range due to ambient temperatures)
- Ideal for supplementing boiler systems to raise overall building heating efficiency well in excess of 100%
- Available on factory Modular Links up to 6 units
- Each module contains microprocessor control w/ LED readout, internal flow switch, gas train safeties, various temperature sensors for unit monitoring and much more…..

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# GAHP-W

## THERMODYNAMIC OPERATING CYCLE

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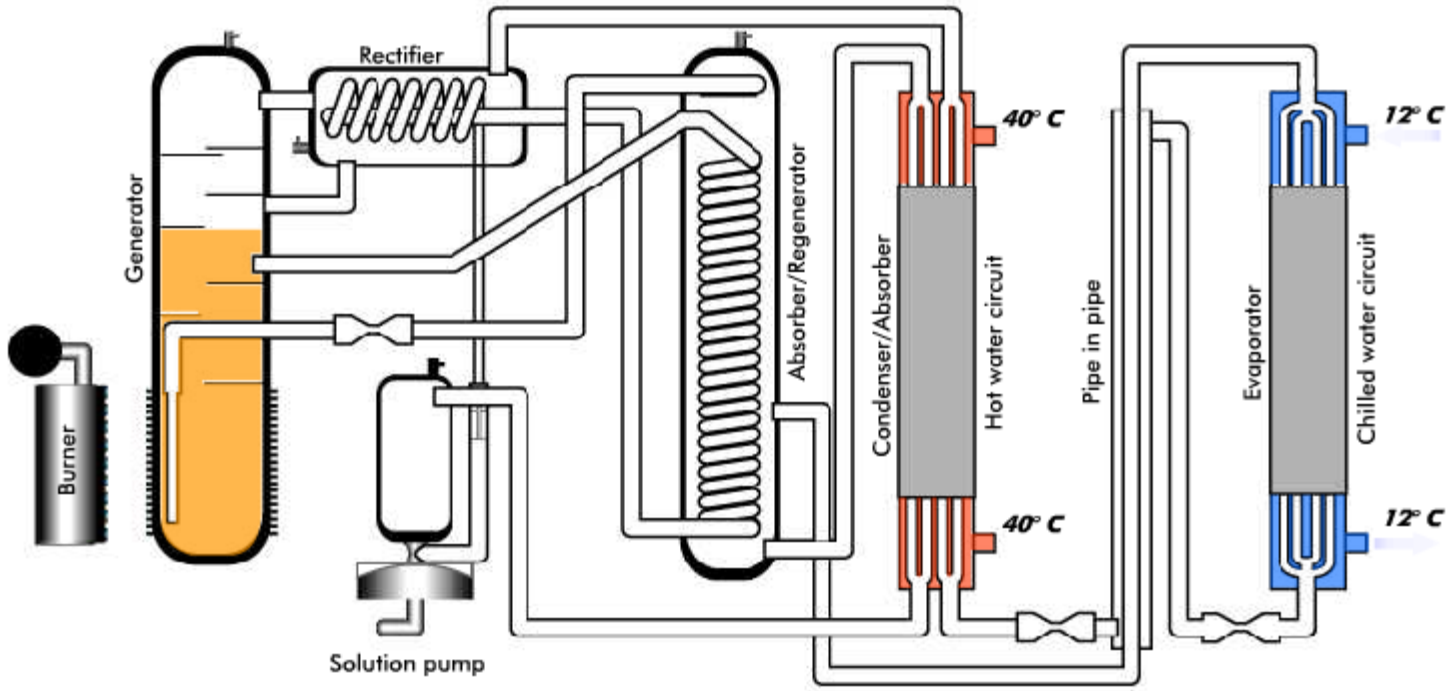


Weak solution | Strong solution | Refrigerant vapour | Refrigerating fluid | Chilled water | Hot water

# Natural Gas Fired Modular Links

# Modular Link Series

Up to 6 Standard air cooled chiller / Heat Pump modules or 4 Chiller-Heaters Modules assembled on a rail set with single point water, gas, and electrical connections

- Unmatched modularity and redundancy provided with each modular link configuration – only use the utilities required to meet building loads and never be with out your heating or cooling with the redundancy already built in
- Any air cooled chiller, heat pump or chiller-heater module can be assembled in various configurations to provide a single system capable of providing Cooling, Heating, DHW and more
- All modules are factory assembled, piped, and wired with single point gas and water connections available at each end of system
- Operates on single phase 208 or 230 volt power supply, regardless of system size
- If optional Robur DDC control is chosen, units are pre-wired for DDC operation
- Links are built to order and are customizable – chose piping material, water line components, mix and match module types to best fit application


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# Natural Gas Fired
# Chiller – Heaters
# Standalone Heaters

The AYF60-119 Series consists of an absorption chiller combined with an 85% outdoor boiler to provide a single unit capable of producing both chilled and/or hot water for HVAC applications.


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# AYF60-119 Series Chiller-*Heaters*


- Available in 2-pipe and 4-pipe configurations for design flexibility
- The Robur chillers coupled with the Robur copper fin tube boiler with AFUE rating of 85%
- Available with ST, HT, TK & LB chillers for even more application flexibility

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# Modular CHILLER/HEATER-*LINK* SERIES

- **RTYF SERIES – 8 to 20 tons cooling with up to 443,600 Btu/h heat**


**Available with**

**ST, HT, TK & LB chillers**

**Factory Assembled, Piped & Wired - 2 or 4-pipe versions**

**Single Point Gas, Water & Electrical Connections**

**Solid State Micro-Processor Controls**

**Variable Speed Condenser Fans**

**Standard 24 Volt Controls**

**Single Phase 208/230 Volt Power Connection**

**Optional DDC Controller**

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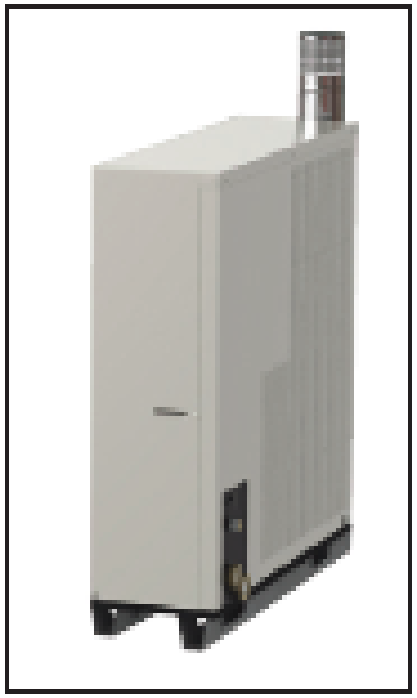
# AY-119/SA

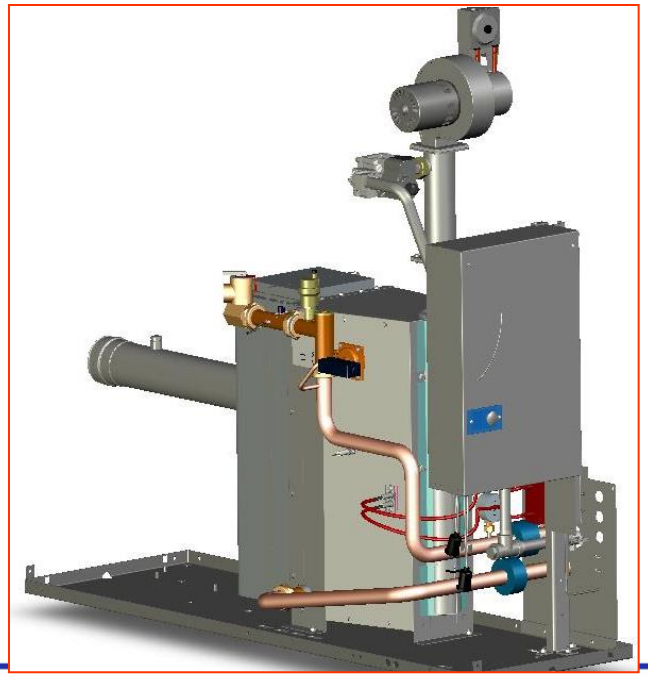
## Stand Alone Boiler



16”W x 48.5”L x 51”H

## Stand Alone Boiler Module

- 85% Outdoor Boiler
- Copper Fin – Tube heat exchanger
- Produces hot water up to 185°F at a capacity of 110,900 Btu/h
- Will operate down to an ambient temperature of -20°F



# Heating Only Systems

## Thermal Module Link

221,800 to 554,500 Btu/h Heat

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# Natural Gas Fired Integration

# Robur DDC Control


- **Direct Digital Contol (DDC) – ›nal for & Can Bus Wire**
  - Manages up to 16 Clg. & Htg.Modules on common hydronic loop.
  - Provides up to 10 Stages.
  - Equalizes run time of Robur Modules.
  - Can maintain a loop temperature without an external call or condition.
  - Can operate as a Summer/Winter switch.
  - Logs and displays fault events.
  - Modbus Communication Capability – More to come.

*For indoor installation or weather tight enclosure in temperatures from 32˚F to 122˚F*

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# DDC Control Advantages

- Equalizes run times across installed modules
- Records module history – Error codes, Run times, Etc...
- Allows managment of up to 96 modules in Multi DDC Plants– 32 per DDC
- Allows remote control of modules from building interior
- Allows additional system enabling (auto call for heat or cool, maintain plant temp, time and temp operation, etc..)
- Allows communication with BMS control through modbus interface
- Allows outdoor reset control for heating and cooling applications
- Maximizes system efficiency by consolidating individual module information
- Allows greater control of plant temperature swings with advanced algorithym
- Allows control of external boiler/ chiller function & DHW control with use of RB200
- And more

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# Natural Gas Fired Projects & Applications

# Department of Sanitation

**NY, NY**
**(90) ACF60 TK**
**450T – Comfort Cooling**


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# JFK Elementary School

**Brewster, NY**
**(30) GAHP AR**
**150T – Comfort Cooling**
**3.6 MMBH – Comfort Heating**

# Park Forest Apartments

**Jackson, MI**
**(18) GAHP AR**
**(4) ACF60 HR**
**2.2 MMBH- Comfort Heating**
**110T – Comfort Cooling**
**348 MBH – Free Heat Recovery**

# Public Library Chinatown

**Chicago, IL**
**(1) RTAR240-480**
**20T – Redundant Comfort Cooling**
**481 MBH – Primary Comfort Heating**

# D'Youville College Science Building

## Buffalo, NY

## (5) RTCF360-TK

## 150T – Conditioning Fresh Air Intake


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# New York University
# Tisch School of the Arts

**NY, NY**
**(10) ACF60**
**50T- Equipment Cooling**

# Golden Town Apple

## Thornbury, ON

## (8) ACF60 TK

## 40T – Medium Temperature Refrigeration

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# Benny Farm

**Montreal**

**(3) GAHP-W LB**

**358.2 MBH – Comfort Heating**

**15.2T – Comfort Cooling**

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# Grace Church

**New York**
**(15) ACF60**
**75T- Comfort Cooling**

## Residence – MA

**(1) RTCF180**

**15T – Comfort Cooling**

## Residence- NJ

**(5) ACF60**

**25T – Comfort Cooling**

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# Air Cooled  Modular Chiller & Heat Pumps

# Why Use Air Cooled Modular Chillers:

- Reduced Sound
- Complement Geo System
- Reduced Footprint
- Reduced Weight (Existing Buildings)
- Reduced Rigging Costs (Fits in Freight Elevator)

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Confidential


Samsung Electronics

# DVM Chiller

North America, Version 2.0

SAMSUNG Internal Use Only

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# DVM Chiller Technical Overview

## Basic

- DVM Chiller is a heat pump that can provide hot or cold water
- Nominal 10 and 15 ton capacities
- Up to 16 can be grouped and controlled as a system using the DVM Chiller module controller
- Dedicated DVM Pro design software

# DVM Chiller Technical Overview

## Technical Specifications

| | | | 208/230V | | 460V | |
|---|---|---|---|---|---|---|
| Model Number | | | AG010KSVAFH/AA | AG015KSVAFH/AA | AG010KSVAJH/AA | AG015KSVAJH/AA |
| Power Supply | | Ø, V, Hz | 3, 208-230, 60 | 3, 208-230, 60 | 3, 460, 60 | 3, 460, 60 |
| Nominal Capacity | | Tons | 10 | 15 | 10 | 15 |
| Efficiency | Cooling EER | | 11.20 | 10.10 | 11.20 | 10.10 |
| | IPLV | | 20.5 | 18.8 | 20.5 | 18.8 |
| Water circuit | Heat Exchanger Type | | Brazing Plate | Brazing Plate | Brazing Plate | Brazing Plate |
| | Connection Type | | 50A Cut Groove | 50A Cut Groove | 50A Cut Groove | 50A Cut Groove |
| Operating Water Temp. Range | Cooling | °F | 41 - 77 | 41 - 77 | 41 - 77 | 41 - 77 |
| | Cooling (If using brine) | °F | 14 - 77 | 14 - 77 | 14 - 77 | 14 - 77 |
| | Heating | °F | 77 - 131 | 77 - 131 | 77 - 131 | 77 - 131 |
| Operating Amb. Temp. Range | Cooling | °F | 5 - 118 | 5 - 118 | 5 - 118 | 5 - 118 |
| | Heating | °F | -13 - 109 | -13 - 109 | -13 - 109 | -13 - 109 |

* Certified efficiency data in accordance with AHRI Standard 550/590. Efficiency data is for single modules only, not combined DVM Chillers

* Specification may be changed without further notification.

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# Pain Point of Air-cooled Chiller Users

- Users are suffered from the products' low energy efficiency
  - Seasonal efficiency of air-cooled chiller is 30% point or more behind compared with water-cooled chiller

Seasonal Efficiency, Company D

**Water-cooled Chiller**

IPLV over 17.0~20.5

**Air-cooled Chiller**

PREMIUM — EWAD (R134a) — IPLV over 15.3

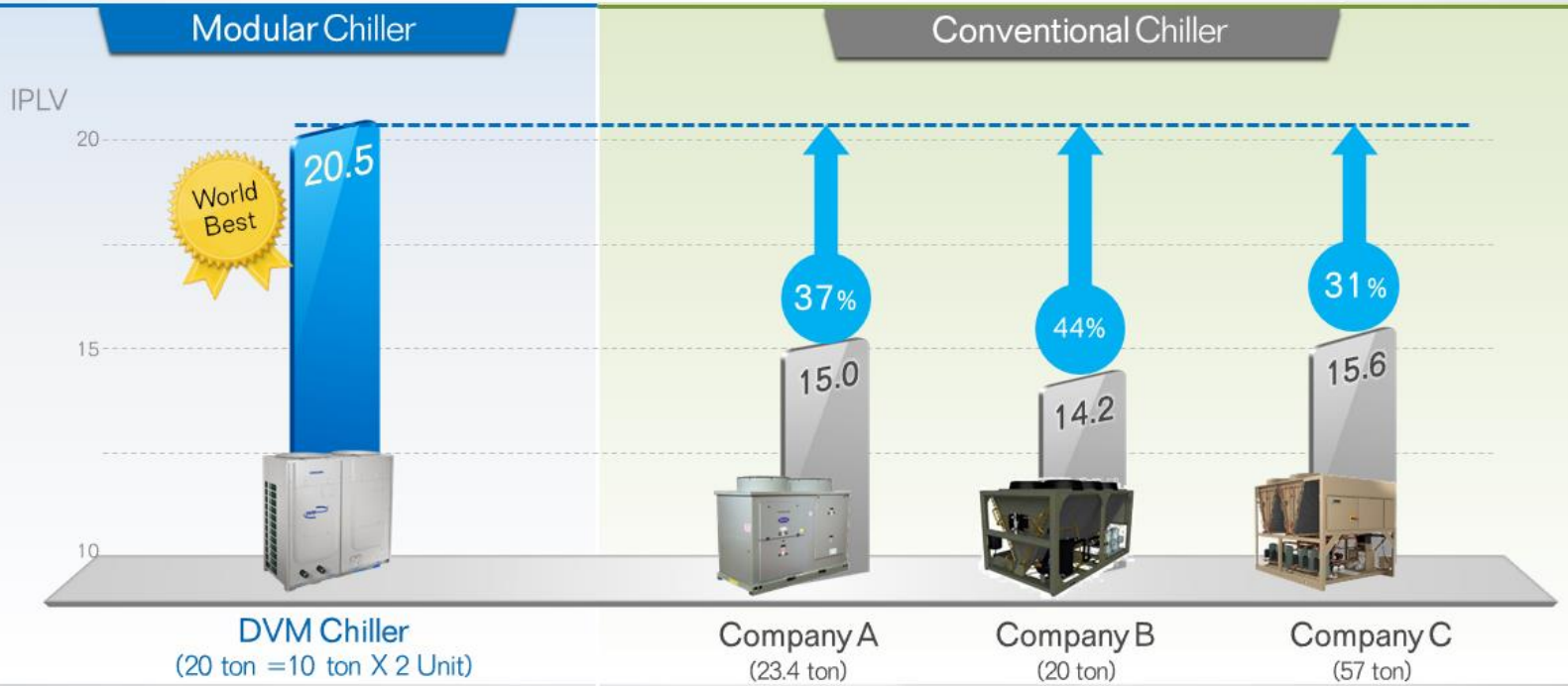
MIDDLE — EWAQ (R410A) — IPLV over 11.9

ENTRY — Old Models — IPLV over 10.2±

# POD 1 World-class Energy Efficiency

- 31 ~ 44% Energy Saving against conventional chiller

(Source: '15y Catalogue)



# Easy Installation

## Small Space


| | Modular Chiller | Conventional Chiller | | |
|---|---|---|---|---|
| | 15 ton | Company A 20 ton | Company B 25 ton | Company C 57 ton |
| Install Area* | 14.75 $ft^2$ | 24.8 $ft^2$ | 39.8 $ft^2$ | 65.6 $ft^2$ |
| Ratio | 100 % | 168 % | 216 % | 156 % |
| Product Volume (Unit) | 82.28 $ft^3$ | 137.0 $ft^3$ | 280.8 $ft^3$ | 480.6 $ft^3$ |
| Ratio | 100 % | 167 % | 273 % | 205 % |

*Including Service Area Based on 560 kW, 8 units)

*Maximizing Utilization of Rooftop Area with Minimum amount of Install Area*

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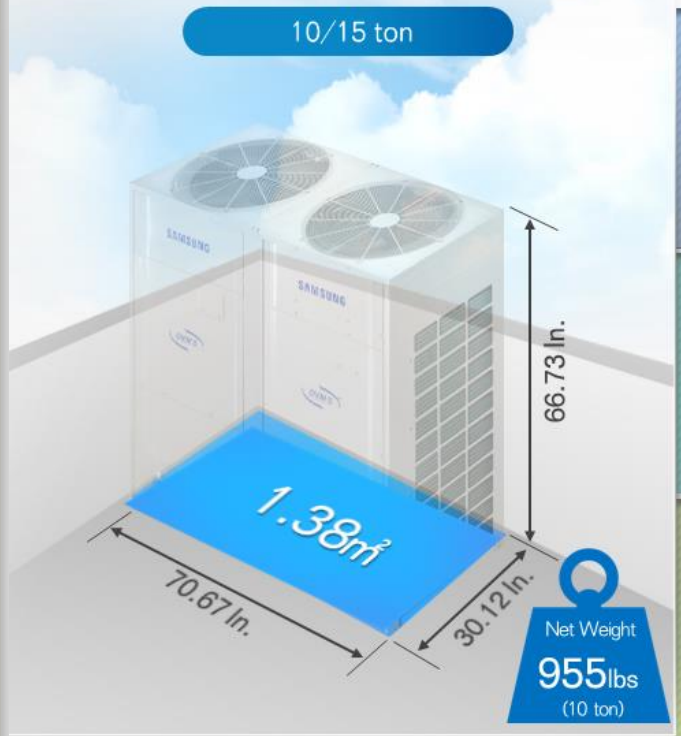
02. Product Features

# POD 2 Easy Installation & Small Space

- Easy Install as DVM S



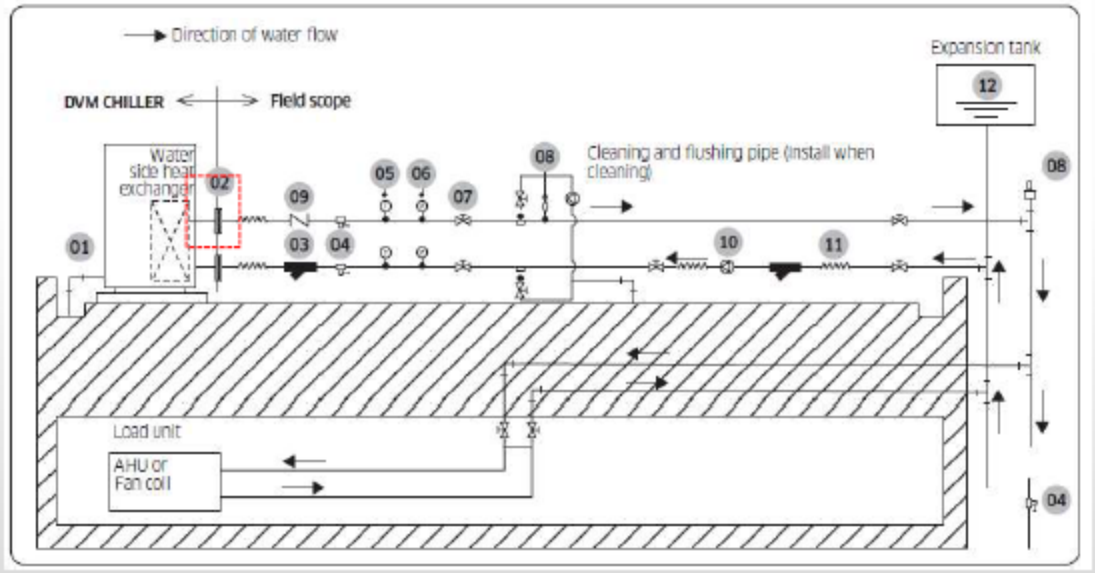

## Transportation & Installation

**Handle**
Forklift

**Transport**
1 Ton Truck

**Lift**
Cargo Elevator

# DVM Chiller
## Water Pipe Installation




| Legend | |
|---|---|
| 01 | Drain plug |
| 02 | Coupling |
| 03 | Strainer |
| 04 | Drain Valve |
| 05 | Temperature Gauge |
| 06 | Pressure Gauge |
| 07 | Valve |
| 08 | Air Vent Valve |
| 09 | Check Valve |
| 10 | Pump |
| 11 | Flexible Joint |
| 12 | Expansion Tank |

*Flexible Joint before the DVM CHILLER must be installed as figure shown.*

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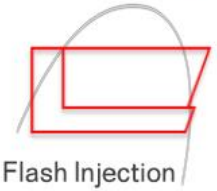
# POD 1 World-class Energy Efficiency

- Secure Reliability and Energy Efficiency with Samsung inverter scroll compressor

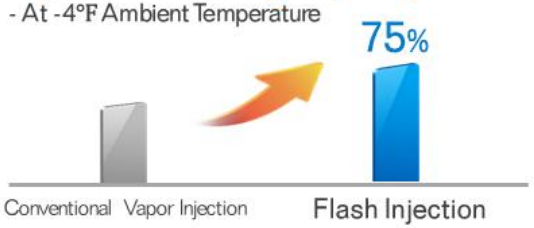
## • Embedded the World-class Efficient BLDC Scroll Compressor


## • Applied Flash Injection Technology




## • Improved Heating Capacity

- At -4°F Ambient Temperature

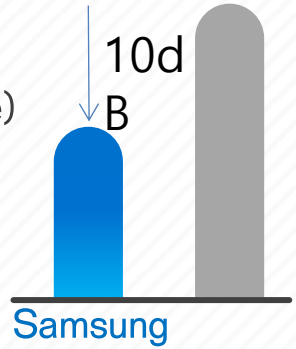


# DVM Chiller Technical Overview

## Features

### 01 Quiet Operation

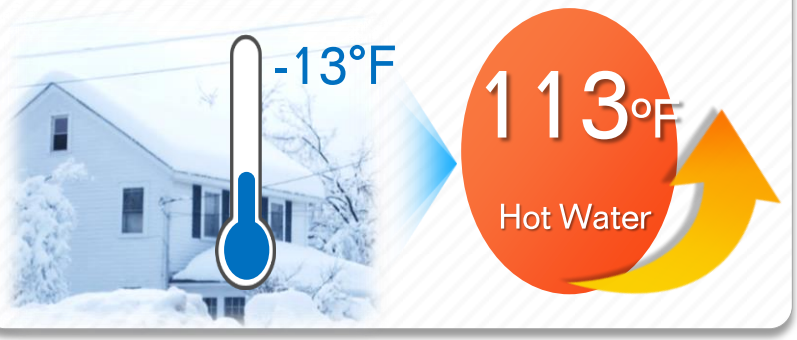
- Low noise levels
  - 60dBA (sound pressure)
  - 3 optional quiet mode settings




( Sound Pressure, 84kW,EU )

### 02 Powerful Heating Performance

- 75% of Heating Performance at -13ºF with Flash Injection Technology

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# DVM Chiller Technical Overview

## Features

### 03 Cold Water Production

- Thermal Ice Storage and High Temperature Difference HVAC
  - High Temp. Difference HVAC
    (max △ 18°F, 59~41 °F)
  - Thermal Ice Storage HVAC (min 14 °F, Brine Temperature)

### 04 Prevents Freezing and Pipe Bursts

- Built-in Differential Pressure and Temperature Sensor
  - Senses water flow volume
  - Prevents PHE from freezing
    (based on refrigerant and water temperature, and water flow)

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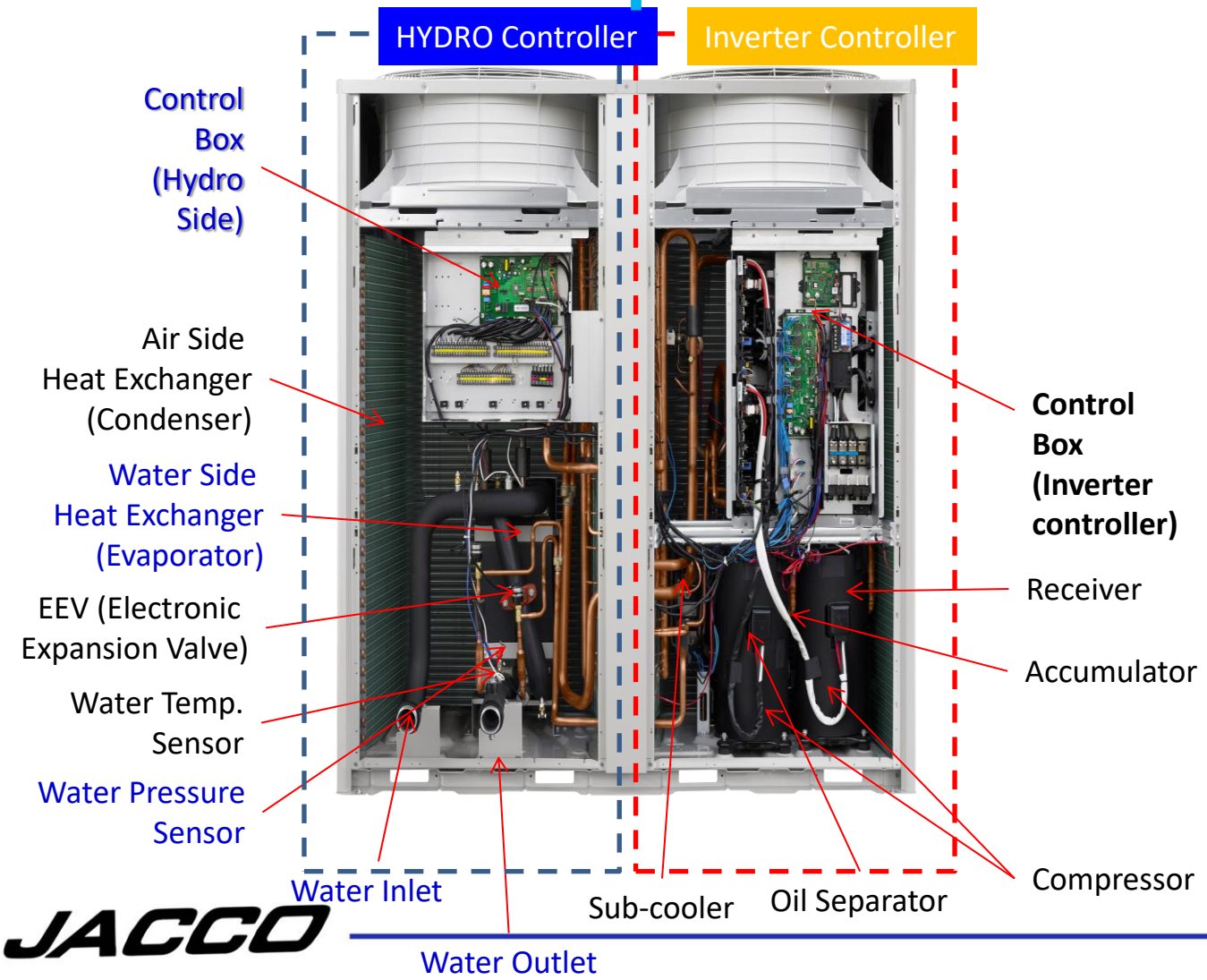
# DVM Chiller Technical Overview

## DVM Chiller Concept

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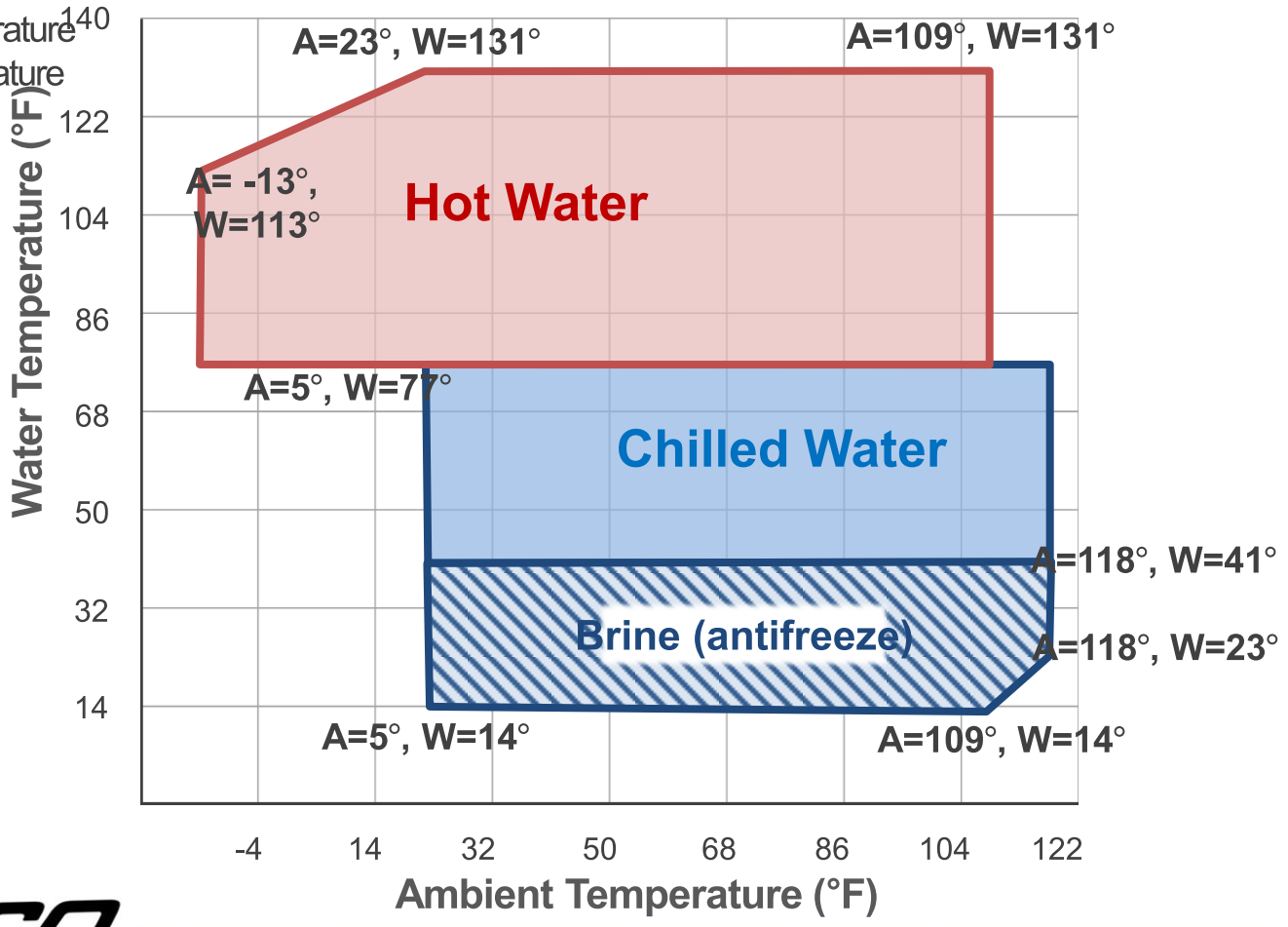
# DVM Chiller Technical Overview

## Wide Operation Range

Can be used for various applications including, Offices, Retail, Hotels, Hospitals, Education, and In

A = Ambient temperature
W = Water temperature

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# DVM Chiller Technical Overview

## Defrost Operation

Sequential and intelligent defrost operation

- Advanced intelligent defrost logic to significantly reduce defrost cycle frequency by monitoring air resistance across the condenser coil and coil temperature during heating operation to determine defrost operation initiation to prevent unnecessary defrost cycles.

- Defrost operation is activated when both coil temperature and the air resistance of DX heat exchanger is decreased to a certain level (based on fan data)

- <30% in defrost at a time


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# DVM Chiller Technical Overview

## Three Different Operation Patterns for Various Requirements

① Rotational Operation / ② Demand Operation / ③ High Efficiency Operation


*Details regarding operation patterns will be covered in a later section

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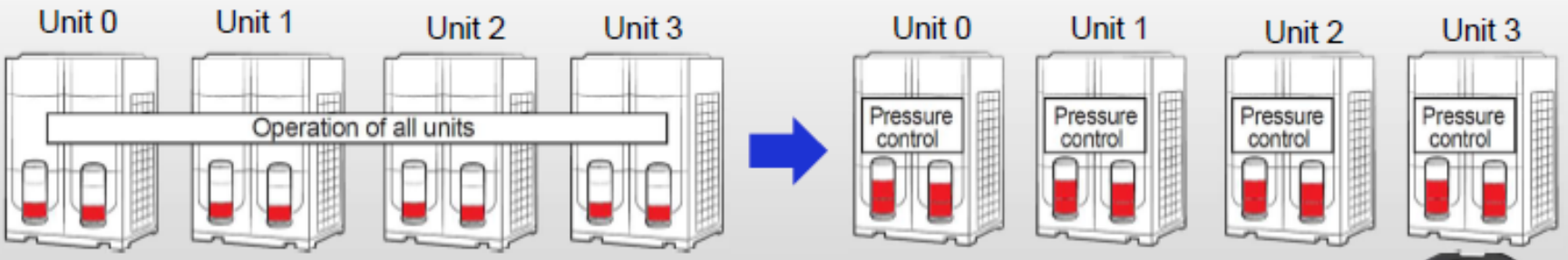
# DVM Chiller Technical Overview

## Operation Patterns

### 1) Standard Control

- All modules start operating at the same time, and each module operates in the operation pattern that was set during system commissioning
- The default for each module is Standard control.
- **Applications: Standard control is suited for applications that always have a high cooling and heating load factor.**
- When a group is configured to operate in Standard Control, individual modules can be configured to operate in Standard, Efficiency, or Rotation control patterns.

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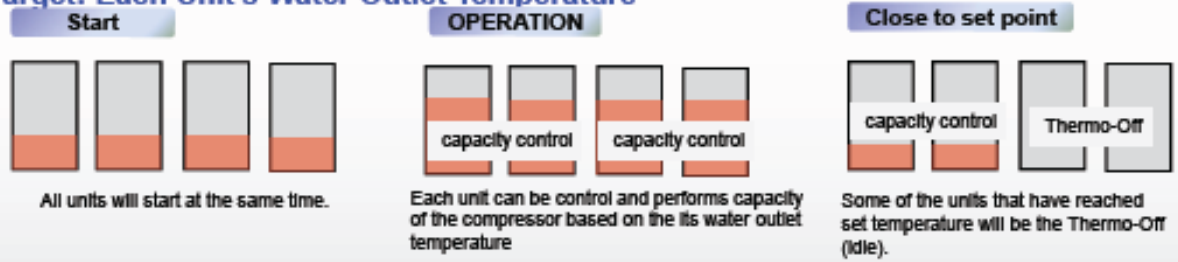
# DVM Chiller Technical Overview

## Operation Patterns

### 1) Standard Control Continued

- Control standards of Water Outlet Temperature: Individual capacity control based on the Water Outlet Sensor in each unit
- Capacity control: When operating, every unit in the modules operate and implements capacity control individually.
- Control Target: Each Unit's Water Outlet Temperature




Starting capacity decision compared to DVM S / DVM Hydro heat exchangers:

- There is no capacity code of indoor unit (hydro section of DVM Chiller) like there is for DVM S indoor units. Since there is only 1 "indoor unit", no capacity code is necessary. The unit simply operates trying to maintain water set temperature.
- Capacity corresponding to whole outdoor units operation
- Capacity control is similar to DVM S capacity control where each unit implements compressor capacity control.

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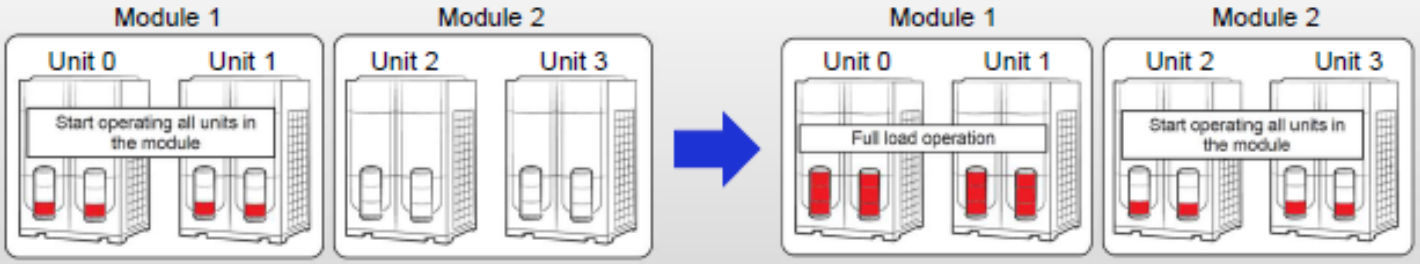
# DVM Chiller Technical Overview

## Operation Patterns

## 2) Rotation Control

- The module with the highest priority starts operating first. When the module reaches full load, a module with the following priority will start operating.
- When the module with the lowest priority operates at the minimum capacity and the water outlet temperature reaches close to the set temperature, the compressors of the module stop.
- DVM chiller's water outlet temperature is controlled according to the water outlet temperature average value of all operating units in a module. If the system is configured to use an external water temperature sensor, it controls the water outlet temperature according to the external sensor's value.
- Modules in a group operate in standard control




Applications: Rotation control is best suited for applications that have lower loads while starting a DVM chiller and has small fluctuation in momentary load.

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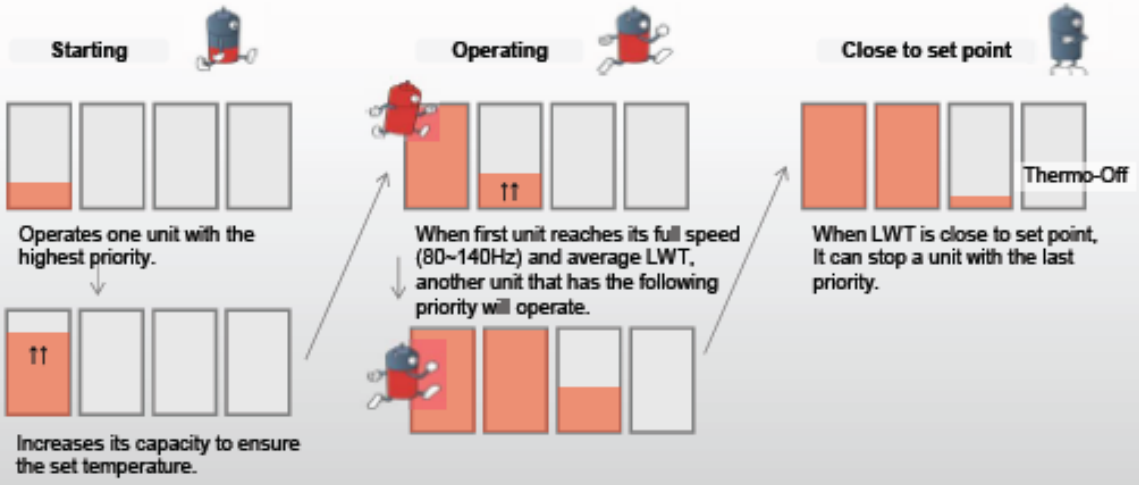
# DVM Chiller Technical Overview

## Operation Patterns

### 2) Rotation Control Continued

- Operates only one unit (module) that has the highest priority, and when the unit (module) reaches full load, another unit (module) that has the following priority will operate.
- When the water outlet temperature reaches the set temperature, it will stop the unit with the lowest priority.
- **Control target: average water outlet temperature of operational (not idle) DVM Chiller units**

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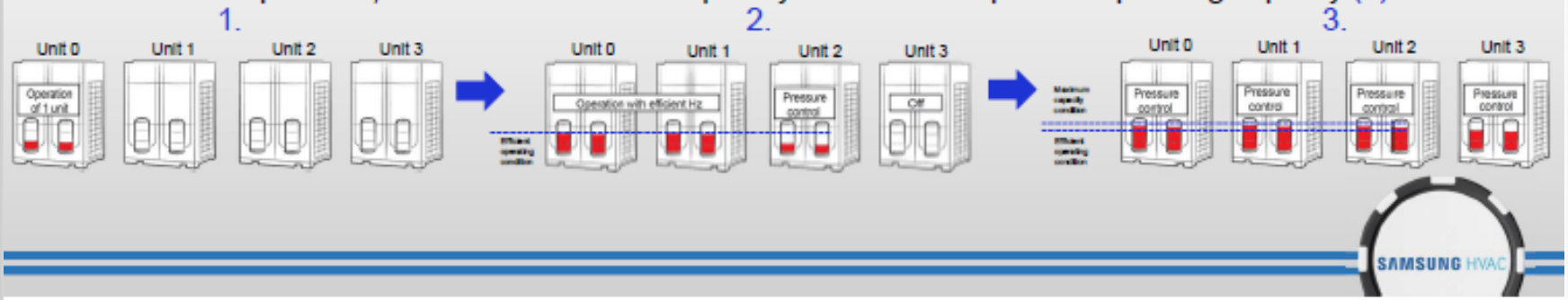
# DVM Chiller Technical Overview

## Operation Patterns

## 3) Efficiency Control

- Inverter compressors are the least efficient at low speeds and really high speeds. They are the most efficient in mid-range frequencies (50 – 80 Hz for DVM S and DVM Chiller)
- While in Efficiency Control Pattern, only one unit with the highest priority operates (1). When that unit reaches the most efficient frequency (compressor speed), another unit with the following priority will operate (2).
- When all units reach efficient operating conditions, each unit then operates at capacities between the most efficient operating condition and the maximum capacity condition.
- When all units reach efficient operating conditions and the water outlet temperature reaches close to the set temperature, the unit with the lowest priority decrease compressor operating capacity (3).

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# DVM Chiller Technical Overview

## Operation Patterns

## 3) Efficiency Control Continued

- When all units operate with the optimum efficiency, they control the pressure of their compressors in a range between higher than efficient Hz and lower than full load Hz separately.
- DVM chiller's water outlet temperature is controlled according to the water outlet temperature average value of all operating units in a module. However, if enable external water temperature sensing (field provided) during system setup, it controls the water outlet temperature according to a temperature value from the sensor.
- **Applications: Efficiency control is suited for applications that have both an operating section with the low load and a focused operating time.**

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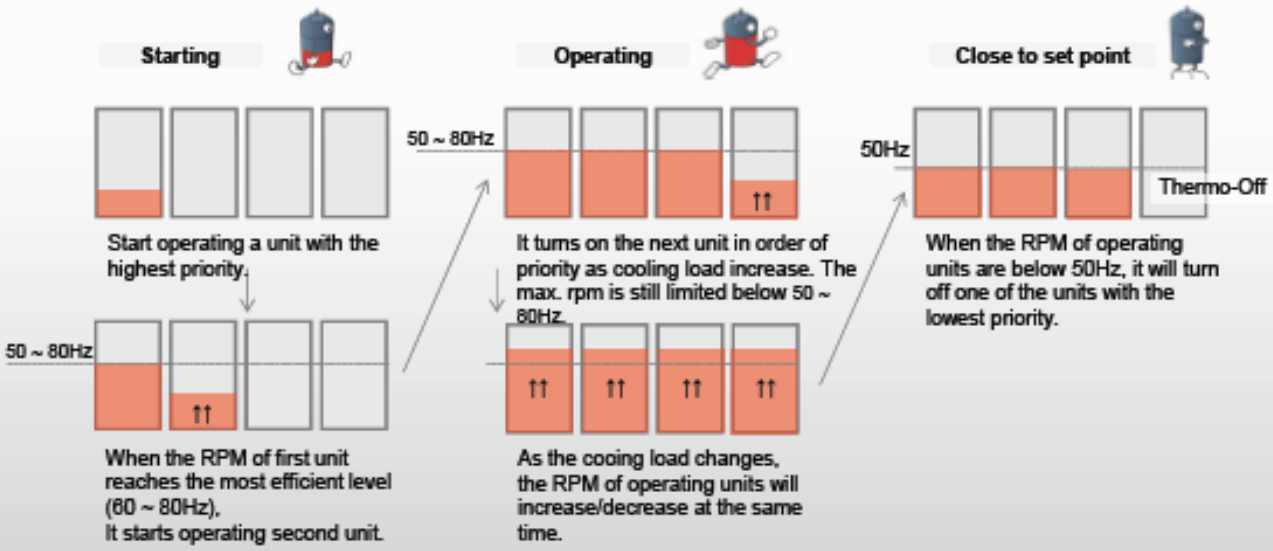
# DVM Chiller Technical Overview

## Operation Patterns

## 3) Efficiency Control Continued

- Operates only one unit that has the highest priority, and if the unit operates the optimum efficiency, the other unit that has the following priority will operate.
- When the RPM of operating units are below 50Hz, it will stop one of units with the lowest priority.

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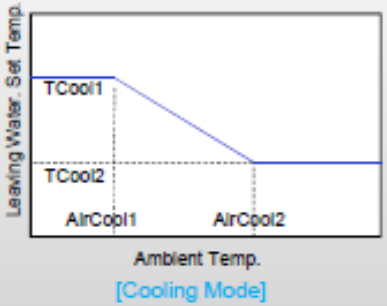
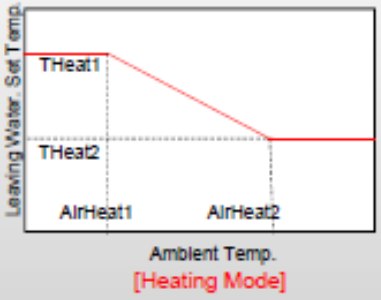
# DVM Chiller Technical Overview

## Water Law

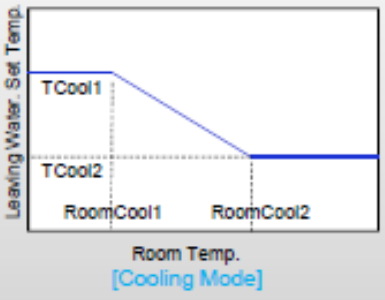
- Optional energy saving option to **automatically adjust leaving water set temperature based on ambient temperature or room temperature**.
- Water Law can configured to change water set temperature based on outdoor temperature or indoor temperature.
- As indoor or outdoor temperature changes, the water set temperature will automatically adjust.
- If configured to monitor indoor temperature, a PT100 temperature sensor must be installed (field provided) or a signal from a BMS must be connected to provide room temperature data.

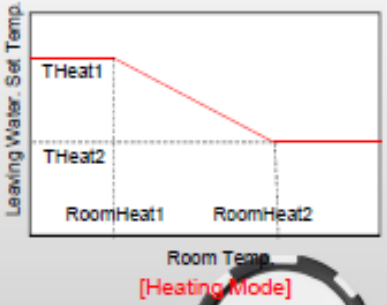
***By Outside Temperature***




***By Room Temperature***

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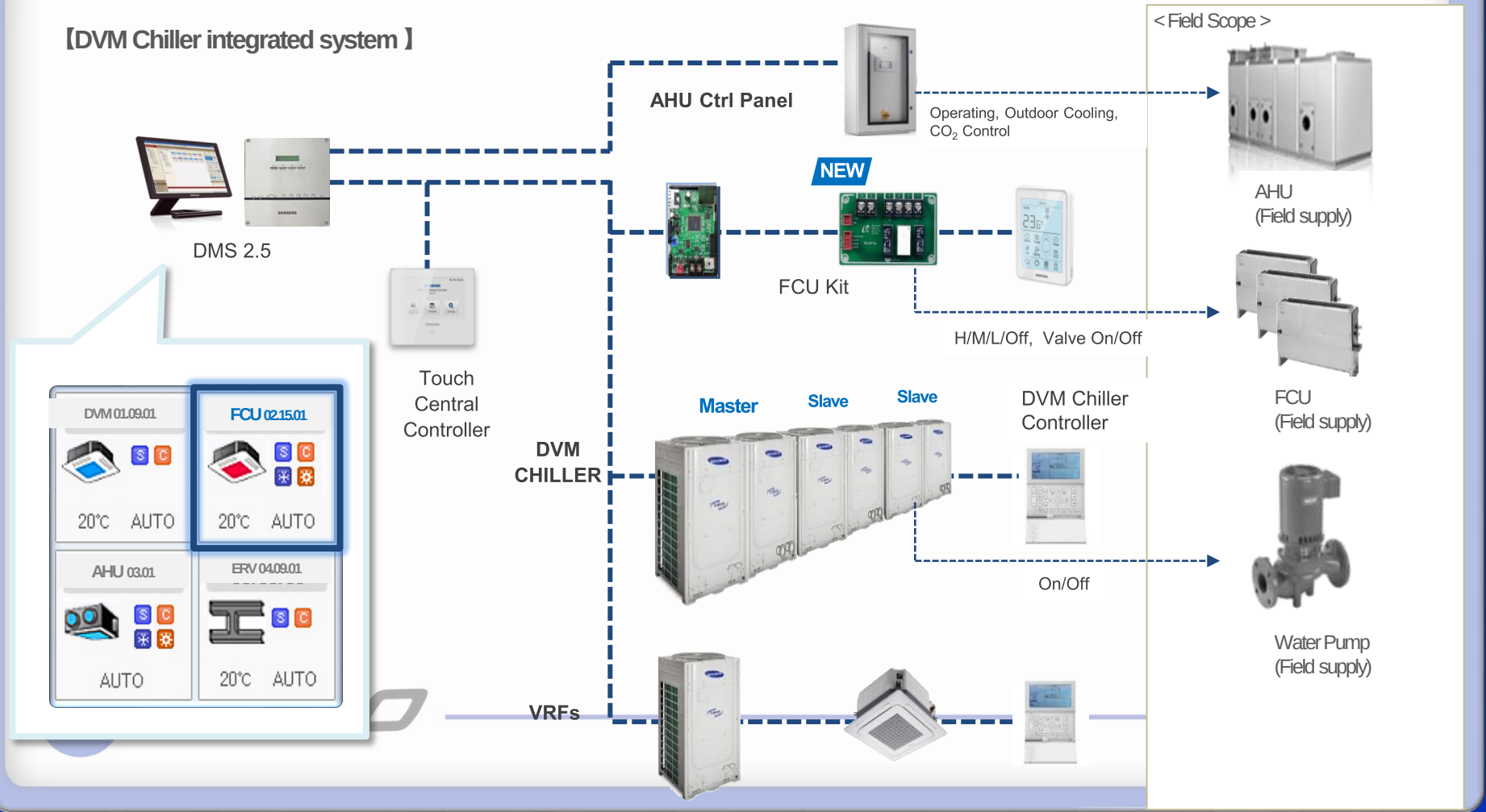
# DVM Chiller

## Integrated Control System

**DVM Chiller provides the integrated control system same as the VRF**



# DVMS Control Options


01

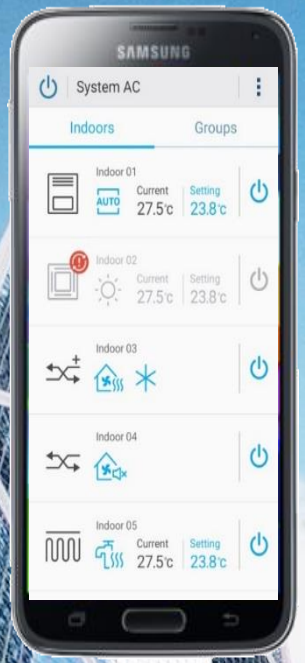
Data Management System

02

Building Management System

03

Centralized Control System



# SNET3

**S-NET 3** is a complex management program that controls and monitors a complete air conditioner network system. The S-NET series provides flexible and complete control for a variety of applications.

- Fully integrated PC management software
- **For large site. (Ex. University)**

Up to **16 DMSs** connection through the Ethernet



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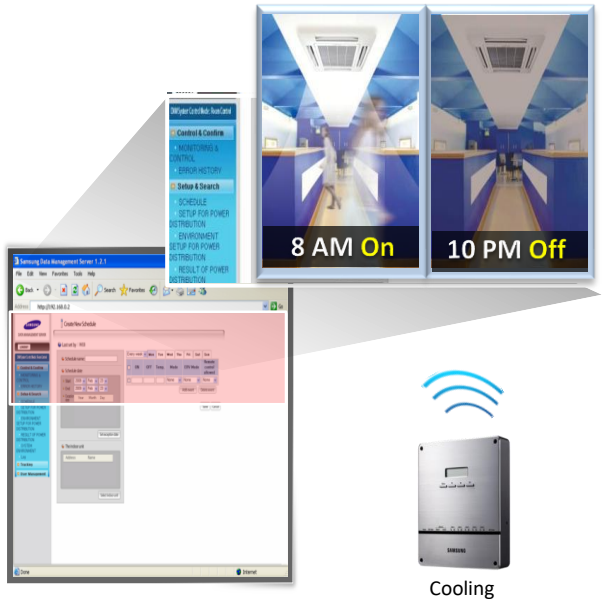
# Data Management System 2.5

## Easy Control Monitoring

- Individual/Group control and monitoring up to 256 indoor units.
- On/off, operation mode, temperature setting, airflow direction and fan speed.
- Wireless/wired remote control restriction.
- Error history query based on date.

## Schedule Control

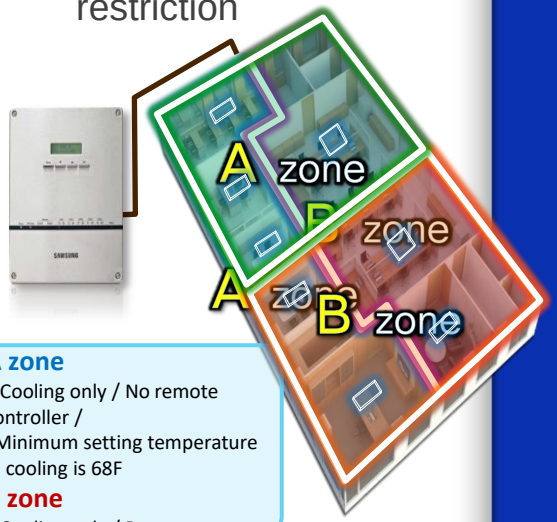
- Up to 256 schedule settings.
- Weekly, Daily or 1-Day schedule control.
- Exception date setting.




Cooling Schedule Setup

## Smart Central Management

- Control & monitoring
- Wireless/wired remote control restriction
- Temperature limit setting
- Operation mode restriction




**A zone**
- Cooling only / No remote controller / Minimum setting temperature in cooling is 68F

**B zone**
- Cooling only / Remote controller use

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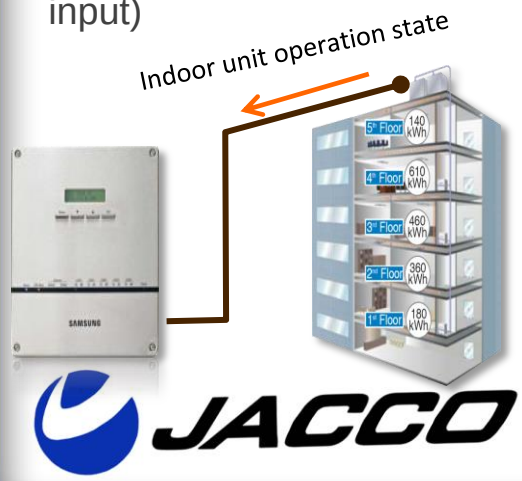
# Data Management System 2.5

## Power Distribution System

- Power distribution to up to 256 indoor units
- Data query for watt-hour, use time and use ratio
- File save in Microsoft Excel format
- 1-year power distribution data storage
- Current actual power consumption monitoring
- Current-type electricity meter support (CT ratio input)

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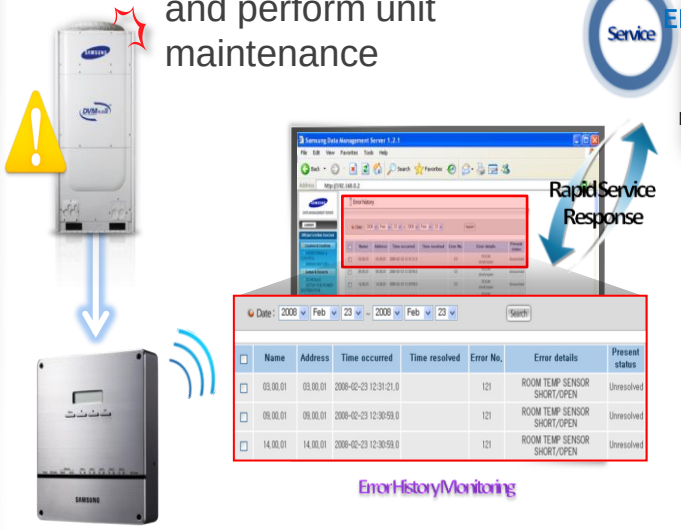
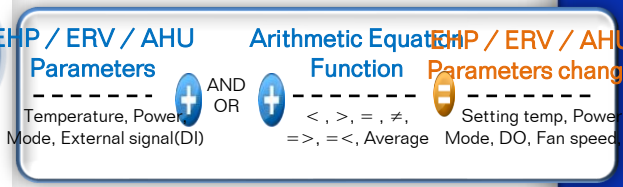
## Error Management

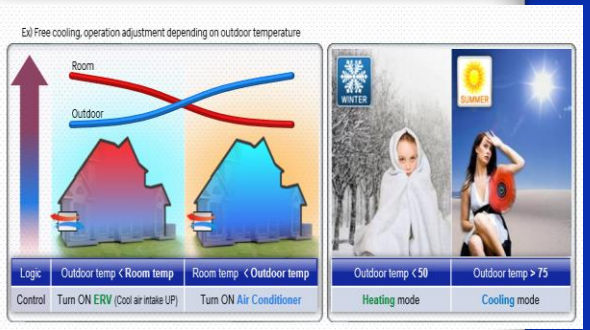
- Easy service and management with operation and error history
- Recorded history makes it convenient to analyze air-conditioner operation and perform unit maintenance




## User Defined Control Logic

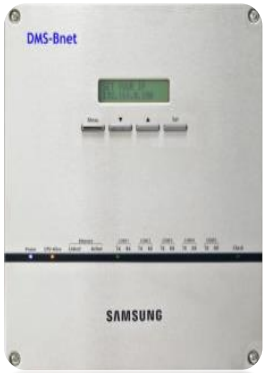
- User can edit control logic with arithmetic/conditional operators and parameters
- Efficient energy saving realization for various



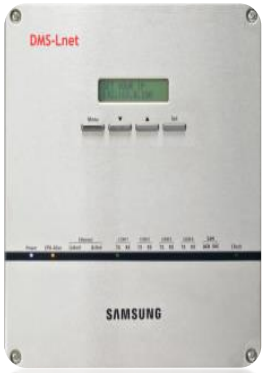
# Building Management System

## BACnet Gateway




- Interface for BACnet management system
- Central management of up to 256 indoor units
- Combination use of S-NET3
- Included DMS2.5 function
- Communication : 485 to BACnet
- Upper physical layer : Ethernet

## LonWorks Gateway




- Interface for Lon-Connection to LonWorks management system
- Central management of up to 128 indoor units
- Combination use of S-NET3
- Included DMS2.5 function
- Communication : 485 to LonWorks
- Upper physical layer : FTT-10A

## BMS Control / Monitoring Functions

**BMS Control Function**

- On/Off control
- Temperature setting
- Operation mode
- Fan speed/direction
- Filter alarm reset
- User control restriction
- Mode lock & set temp limit
- Emergency stop

**Monitoring Function**

- On/Off control
- Set/Room Temperature
- Operation mode
- Fan speed/direction
- Filter alarm
- User control restriction
- Mode lock & set temp limit
- Power Distribution
- Error information

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# Centralized Controller

## Multi Wi-Fi Kit

### Easy Mobile Control and Monitoring


## Easy Interface

### Easy Interface for 7 Day Scheduling


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# Individual Control System

## Wired Remote Controller

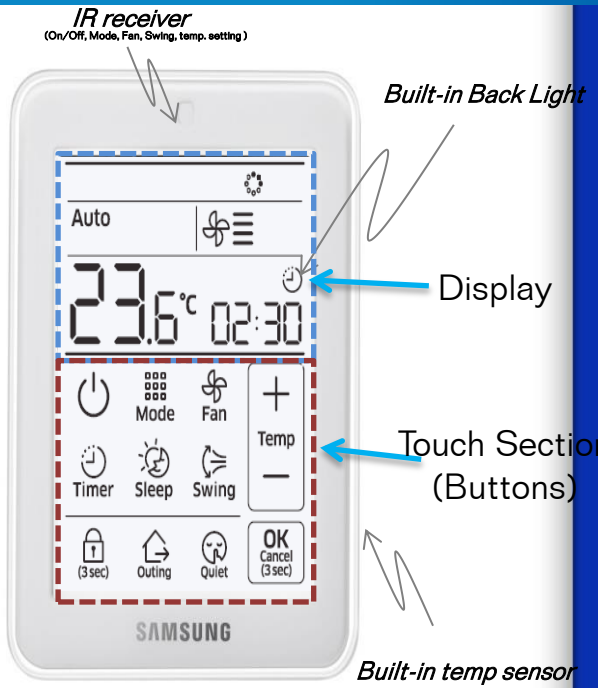
### MWR-WE10N (Multi Function)


- Built-in room temp. sensor
- Clear & Bright LCD Screen
- Motion detection sensor hardware on/off (mini 4-way)
- Control, monitoring, & error display
- Sleep & Silent Mode
- Weekly Schedule

### MWR-SH00N (Simplified)


- Internal temp. sensor
- Backlight
- Built-in infrared receiver to allow control of indoor unit wirelessly
- All button lock
- Skip specified mode on wired controller
- Function and Operation indication

### MWR-SH10N (New)




**Intuitive User Interface**

**Premium Design**

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# DVM Chiller Applications

- K-12 Education
- Colleges/Universities
- Dorms
- Condos/Apartments
- Assisted Living
- Hospitals/Satellite Hospitals
- Hotels/Motels
- Offices

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# Why Use Water Cooled Modular Chillers:

- Efficiency of Water Cooled
- Reduced Sound
- Units Placed Indoors
- Reduced Rigging Costs (Fits in Freight Elevator)

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# MODULAR DUAL SCROLL CHILLER

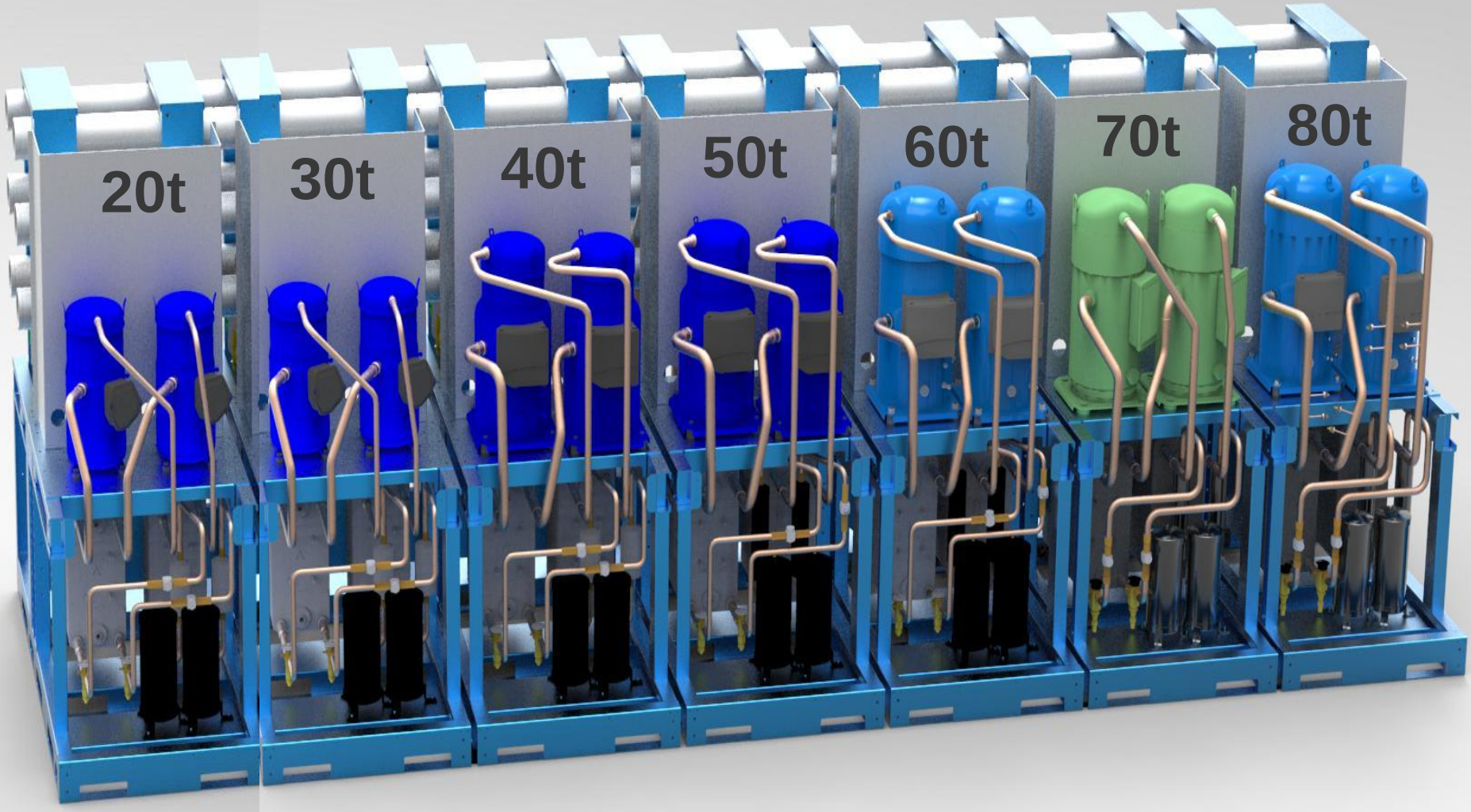
WaterFurnace®
Commercial Solutions

# MODULAR DUAL SCROLL WITH PIPE RACK

- New Design
- Models 20-80 ton
- R410A
- Heat Recovery or Reversing versions
- Pipe Rack option
  - 4 Reversing
  - 4 Standard
  - 6 Standard
  - 6 Dedicated

WaterFurnace®
Commercial Solutions

# SEVEN SCROLL MODELS 20 TO 80 TON



# Features

**Dual scroll compressors** for efficiency and reliability

**High efficiency brazed plate heat exchangers** for efficiency and compact size

**Heavy gauge insulated sheet metal cabinet** to reduce noise

**Small modular design** for application flexibility

**Fully insulated heat exchanger, refrigerant piping, and water lines** to prevent condensation at reduced fluid operating temperatures

**Stainless steel bi-directional EEV** for precise superheat control

**Heavy gauge steel welded frame** to reduce vibration

**Optional electronic expansion valve** for improved performance across the operating range

**Fork truck pockets** for maneuverability

# MODULAR SCROLL CHILLER FEATURES

- Capacities of 20, 30, 40, 50, 60, 70, and 80.
- Voltages of 208-230/60/3, 460/60/3, or 575/60/3
- Oversized BPHX with low pressure drop
- True dual circuit BPHX for improved part load efficiency
- HydroLink/Aurora Controls featuring the field proven Aurora compressor management and the powerful NiagaraAX based HydroLink system controller

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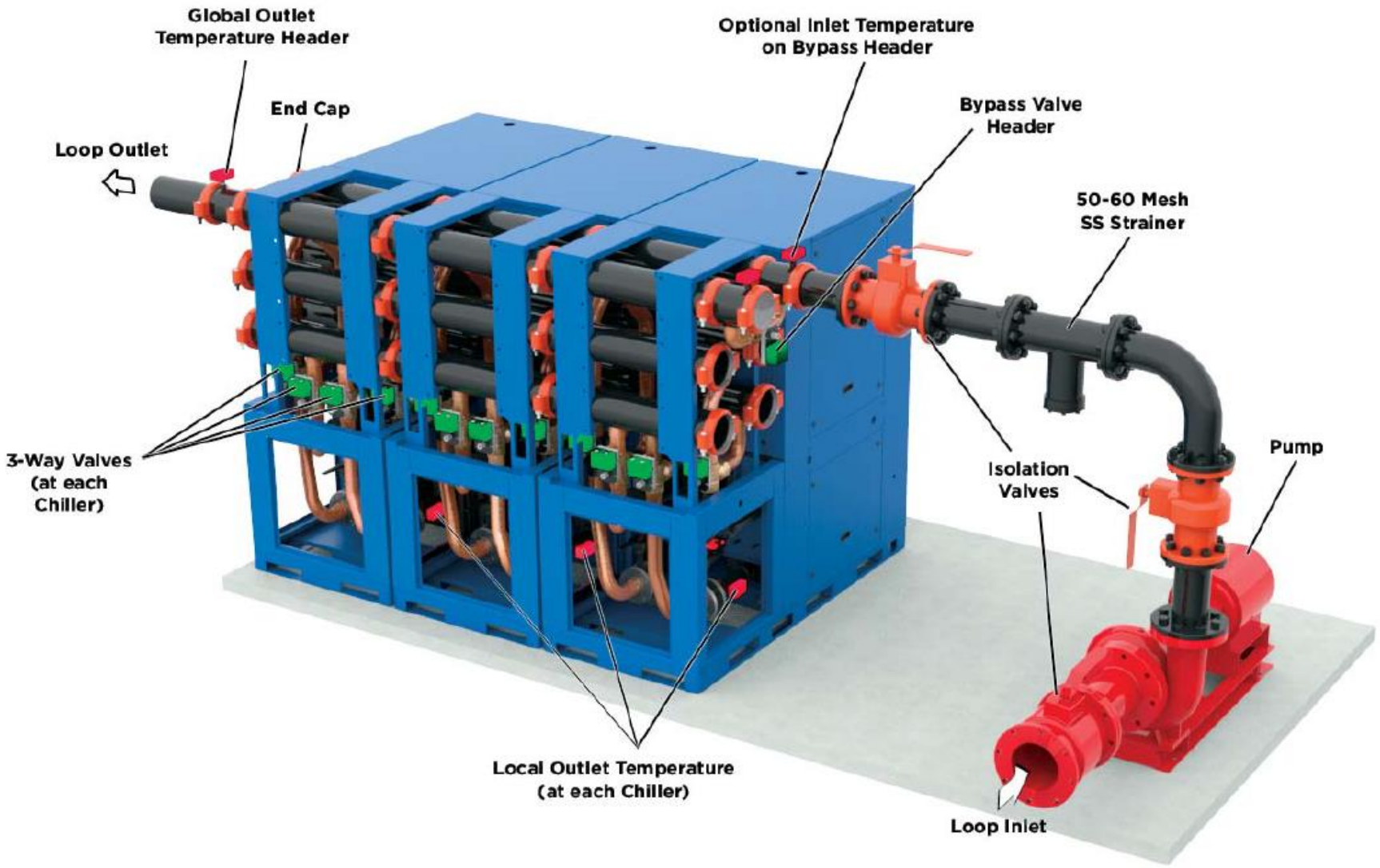
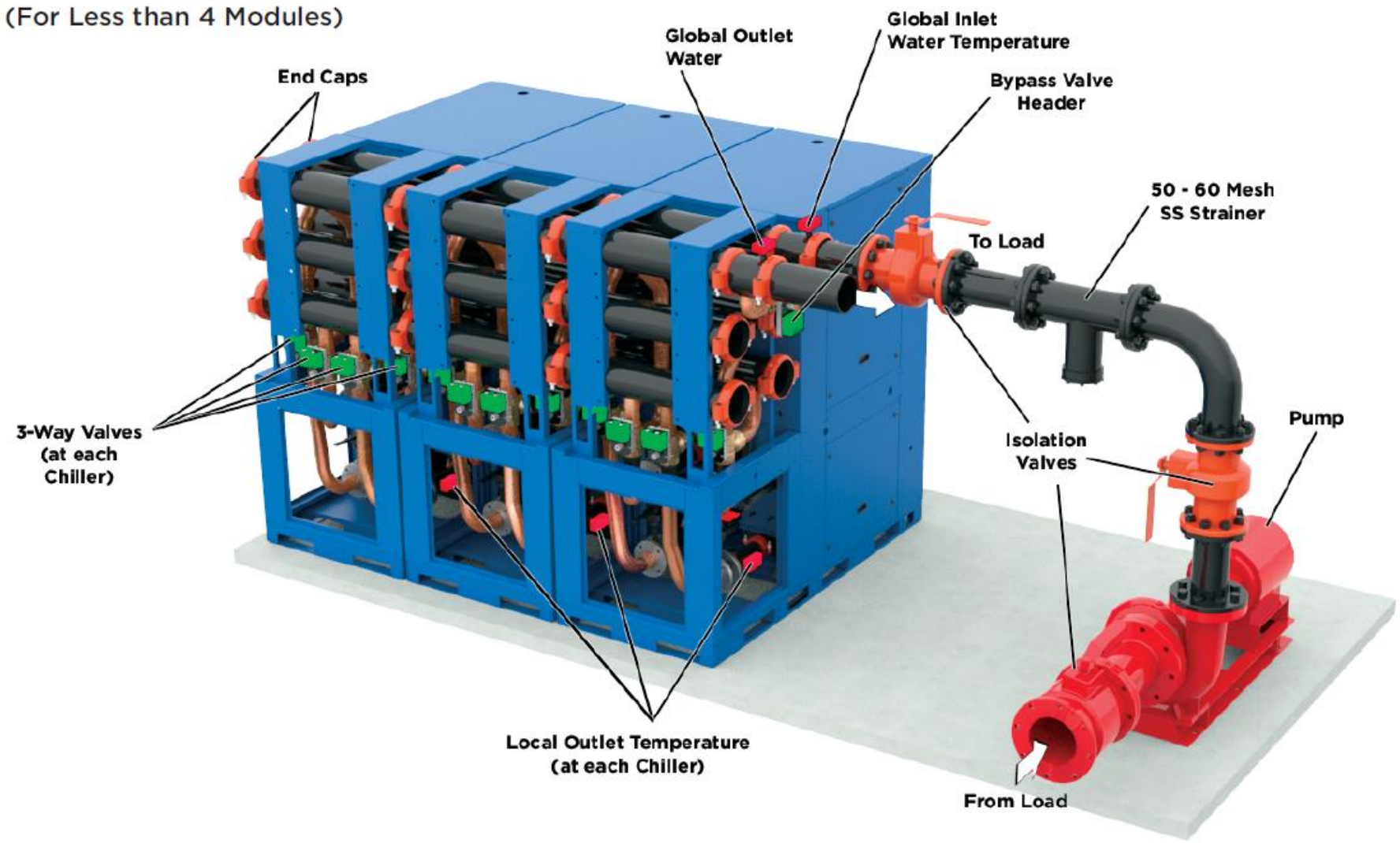
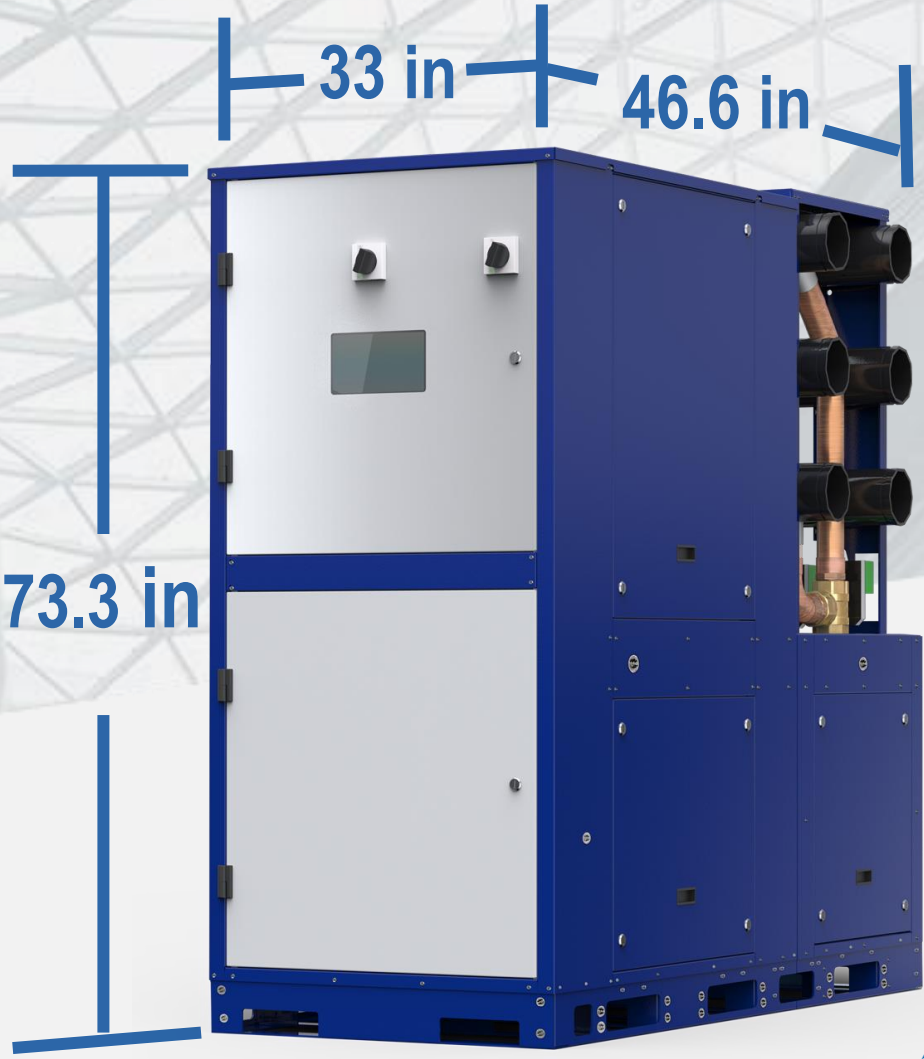
# TYPICAL REVERSE RETURN APPLICATION (RECOMMENDED)



# DIRECT RETURN APPLICATION (< 4 MODULES)



# MODULAR CHILLER DIMENSIONS

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## THE OTHER MODULARS?

Once in place most modular chillers are difficult to service.

## THE TRUE MODULAR CONCEPT

We have the Solution!

1. Fork truck pockets in front to remove from within bank
2. Hinged low Voltage box allows better service access.
3. Remove control box and top panels and service from front or top.
4. Chiller can be isolated and removed from pipe rack.

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# UNIT SERVICEABILITY IN A BANK: THE REMOVABLE CONTROL ASSEMBLY

**Sequence of Disassembly:**

1. Remove power supply
2. Remove Top Panel
3. Remove Frond Doors
4. Disconnect wire harness plugs and communication wires.
5. Completely remove control panel

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# UNIT SERVICEABILITY IN A BANK: BENEFITS

- The serviceability of the compressors, pressure sensors, unit wiring is possible  without detaching the units.
- The new orientation of the compressors provide quick and easy access to the compressor power module, pressure switches and pressure transducers.
- The hinged control box provides for easy access to the filter driers and txv’s.

# Control Box Features

**Control box** is removable from the front to provide access in case of service part replacement

**Low voltage panel** is hinged to provide easy access to refrigerant service ports

# HEADER PIPE RACK

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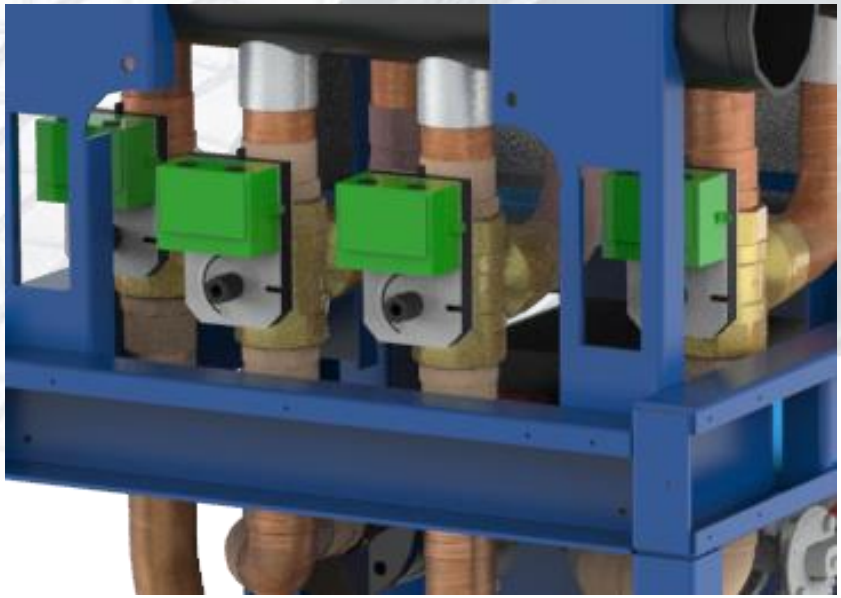
# HEADER PIPE RACK FEATURES

- Four pipe Rack Styles - 4 Reversing, 4 standard, & 6 dedicated source, and 6 standard.
- Pipe Sizing of 4”, 5”, 6”
- Patented 3 way valve design
- Fork Pockets/Slide out frame
- Serviceable 3-way valves
- Global sensors relocated to bypass assembly
- Plug-n-play wiring for sensors
- Isolation valves between chiller



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# HEADER PIPE RACK

**4", 5" or 6" Pipe Victaulic or Flange**

**Exlusive 8-mode operation of header** including simultaneous hot and cold setpoints

**Modulating 3-way valve**

**300 PSI rated**

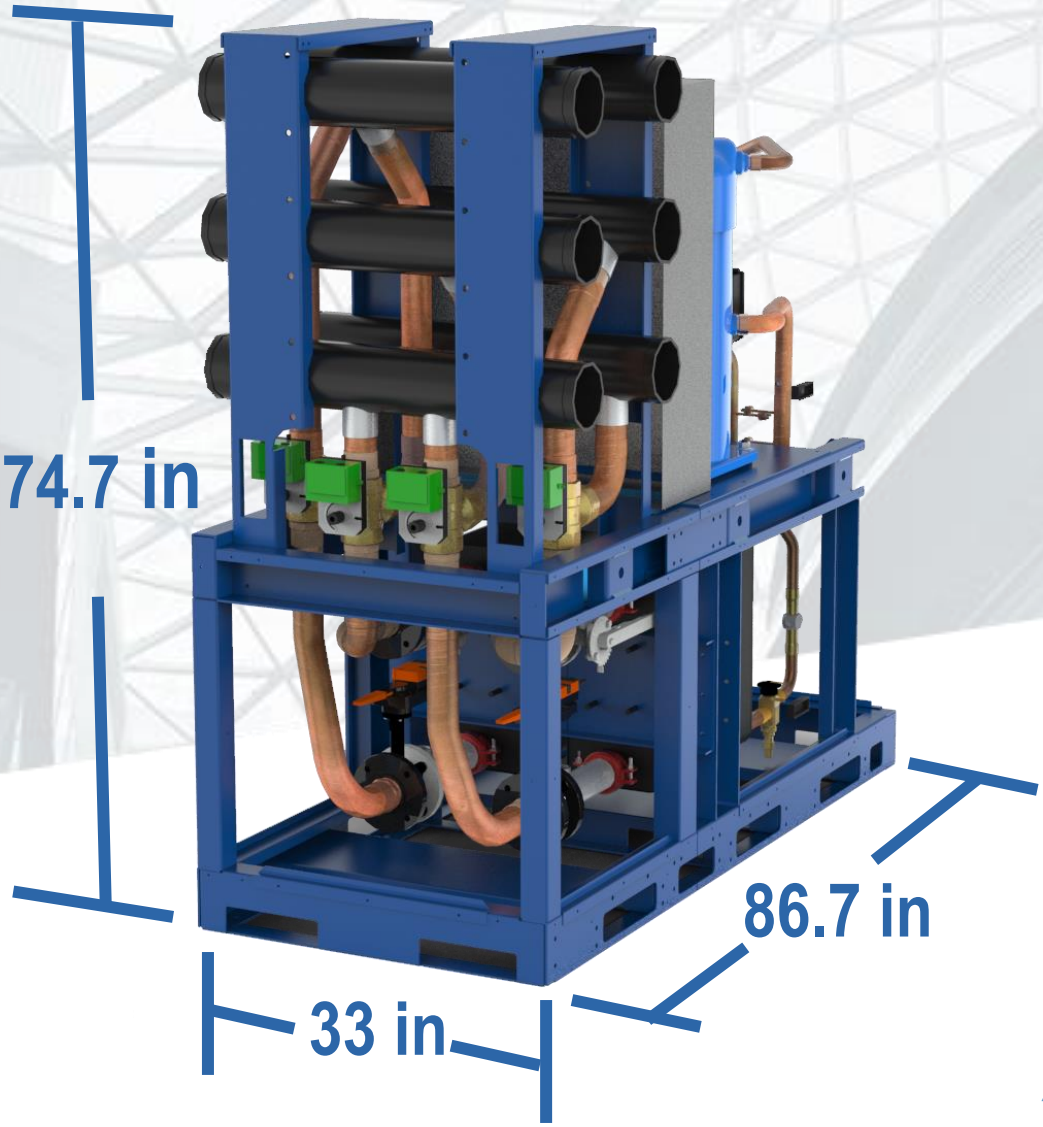
**Alignment channels** for easy separation of unit and pipe rack

**Integrated isolation valves** (motorized on unit

**2-1/2" Inlet/Outlet**

**Integrated isolation valves** (manual on unit outlets)

# HEADER PIPE RACK DIMENSIONS

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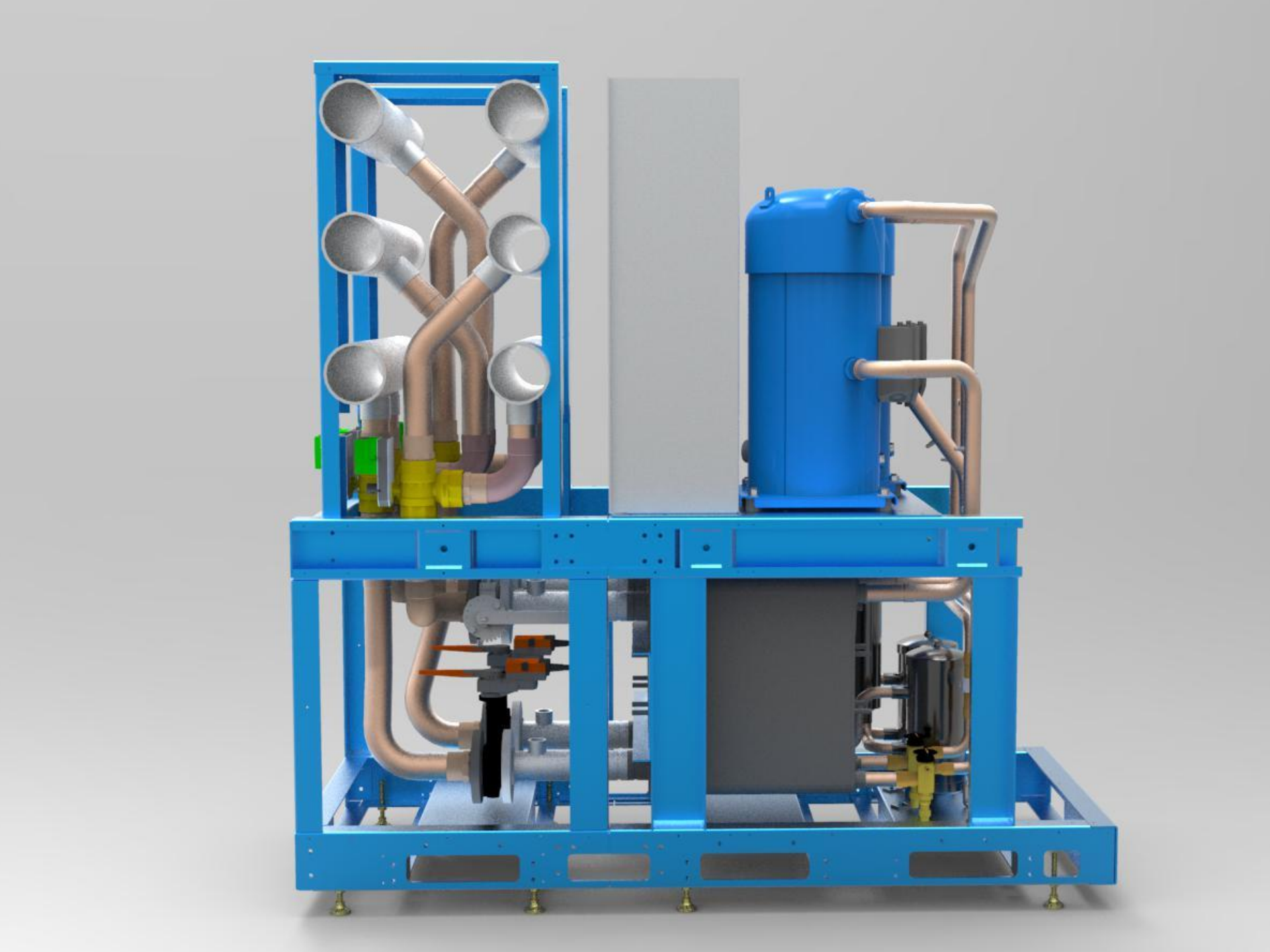
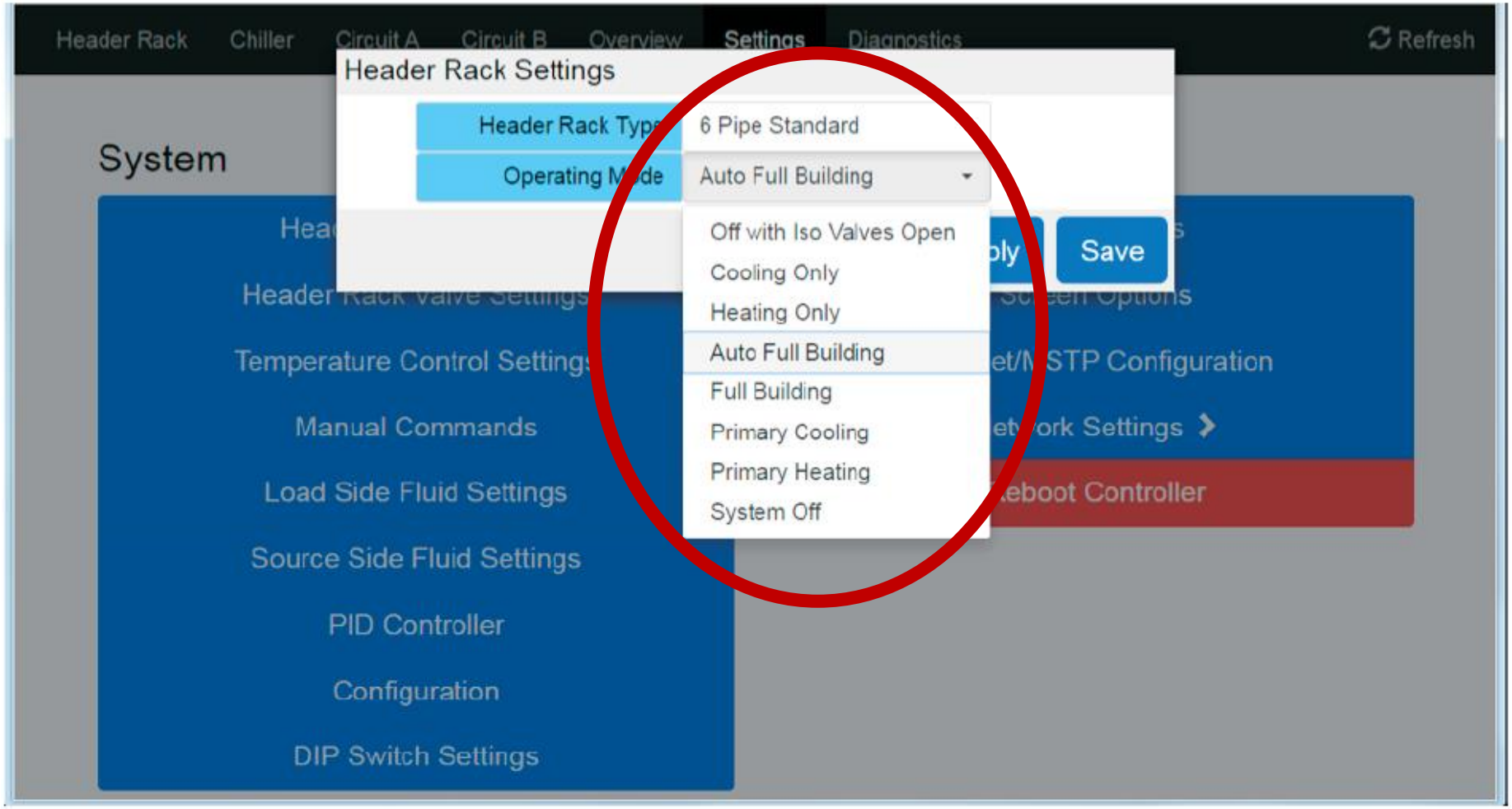
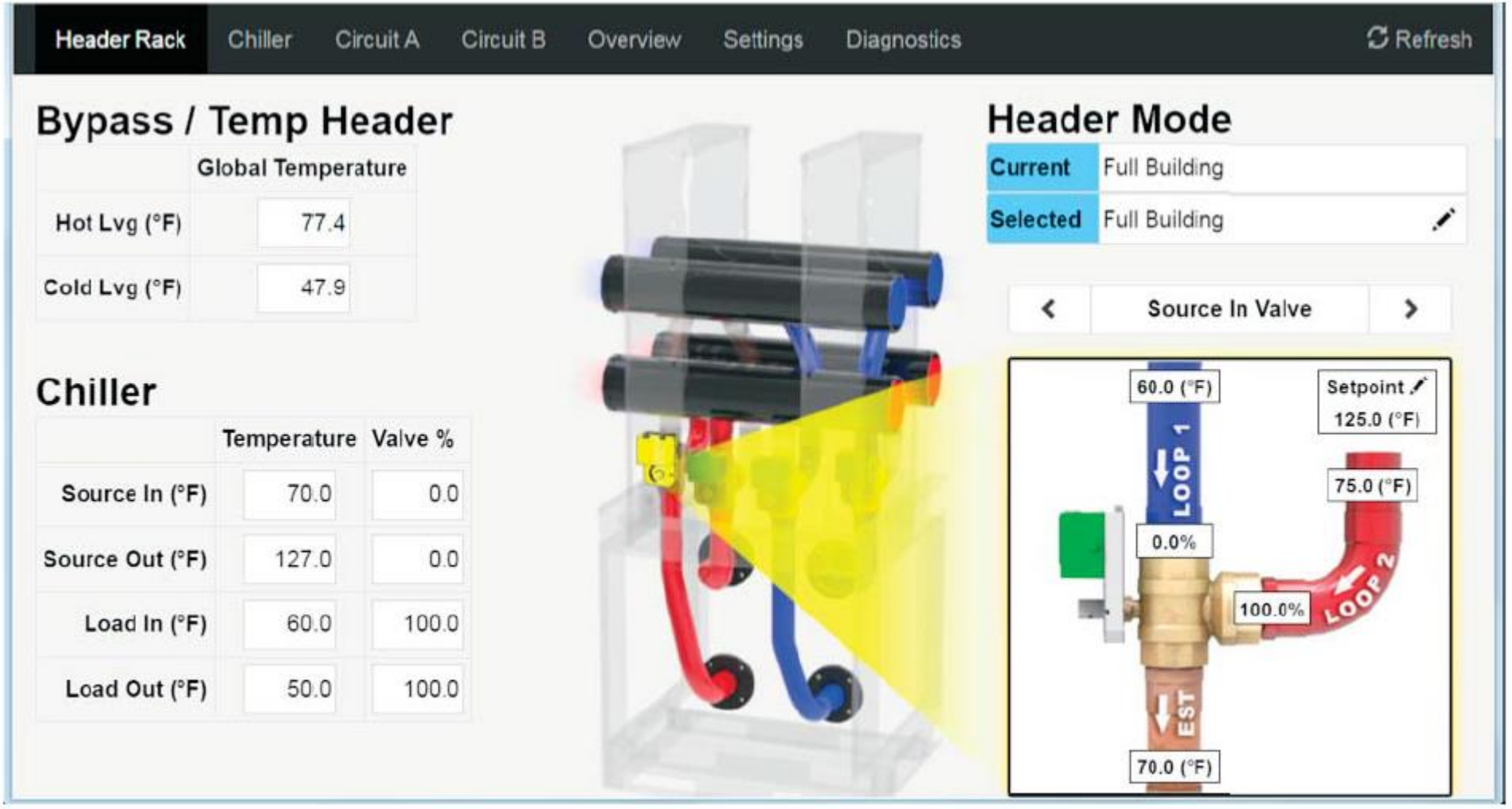


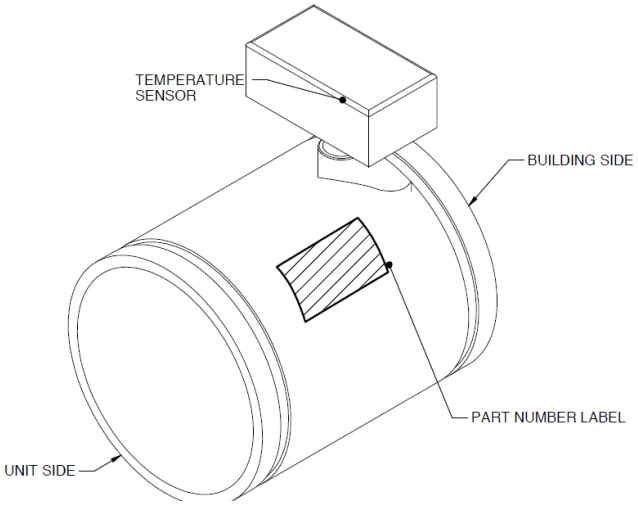
# SEVEN MODES OF PIPE RACK OPERATION

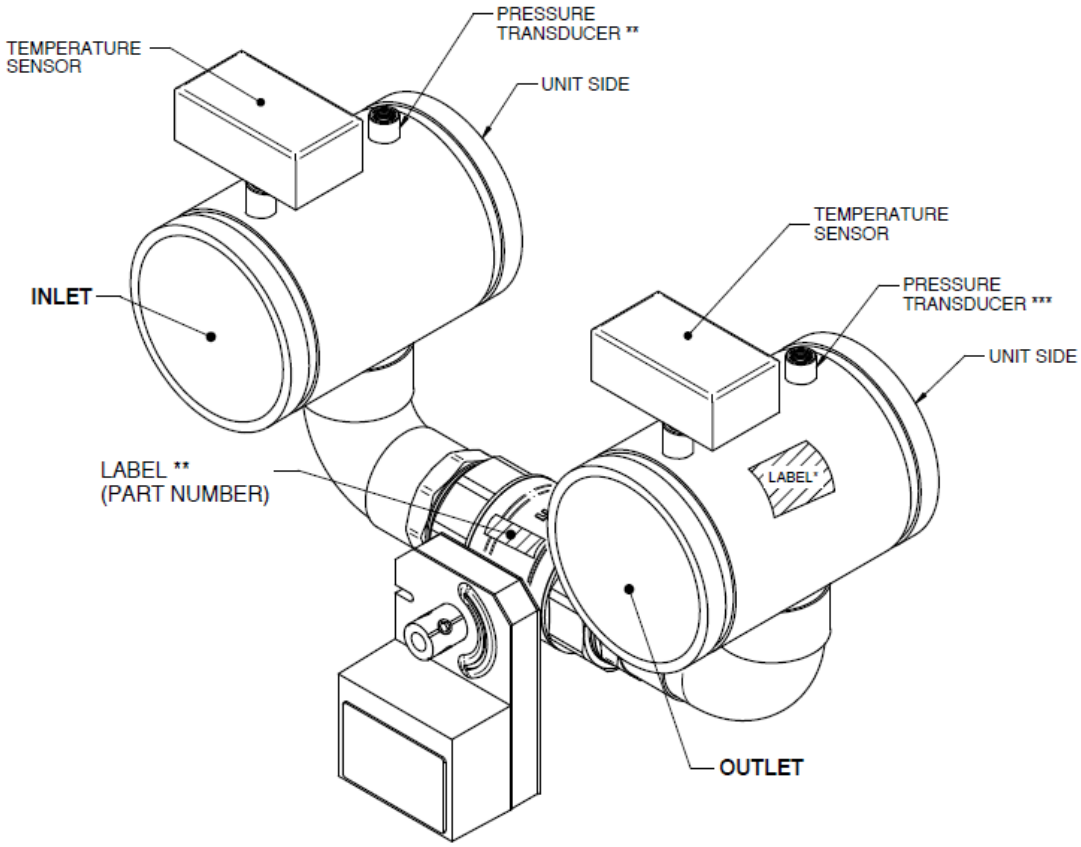


# FULL GRAPHIC DISPLAY OF PIPE RACK OPERATION

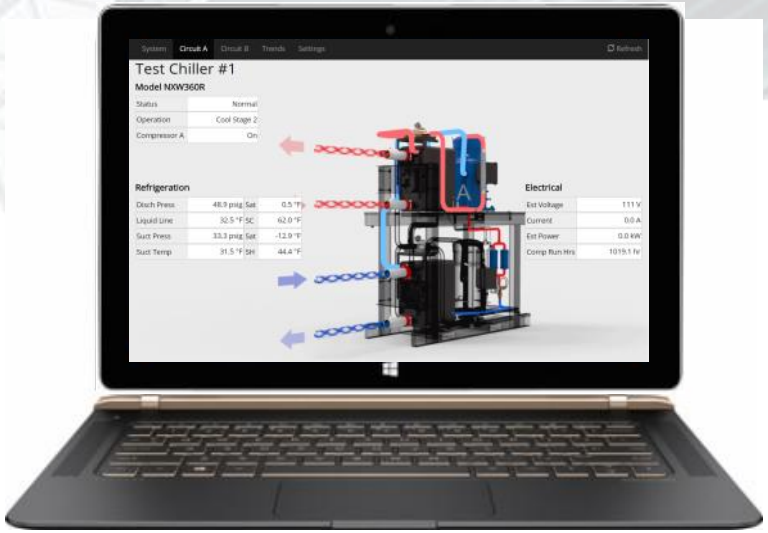


# TEMPERATURE & BYPASS HEADERS



# HYDROLINK / AURORA CONTROLS



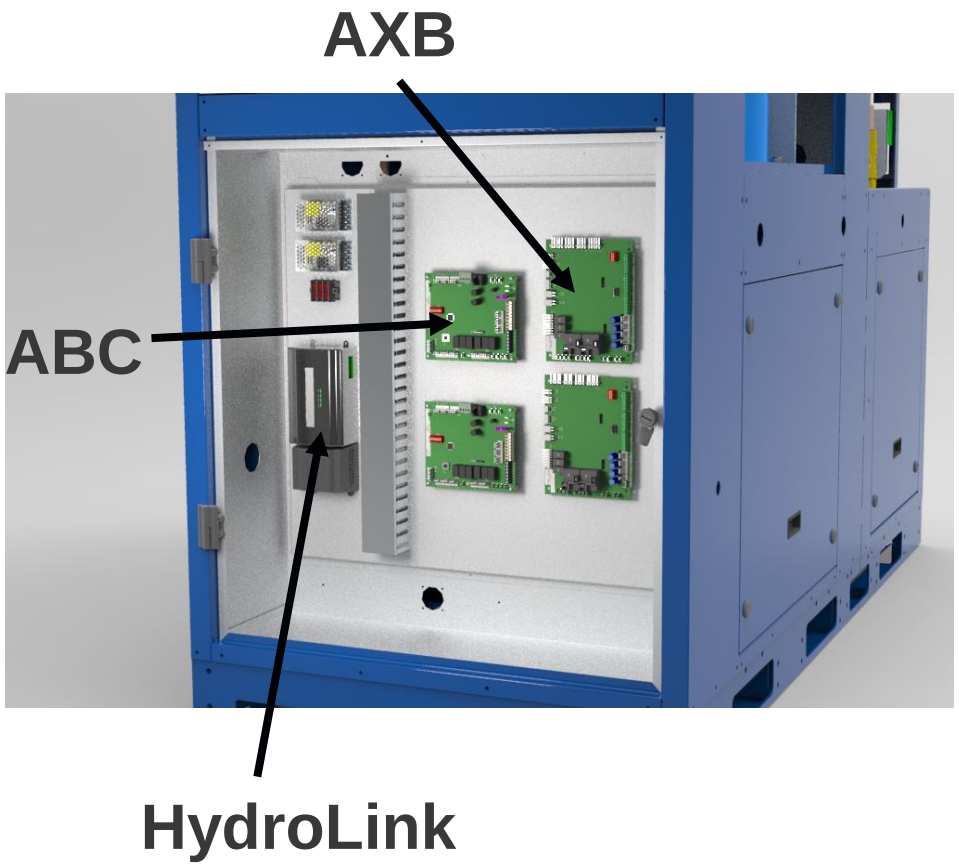

HydroLink AURORA

WaterFurnace Commercial Solutions

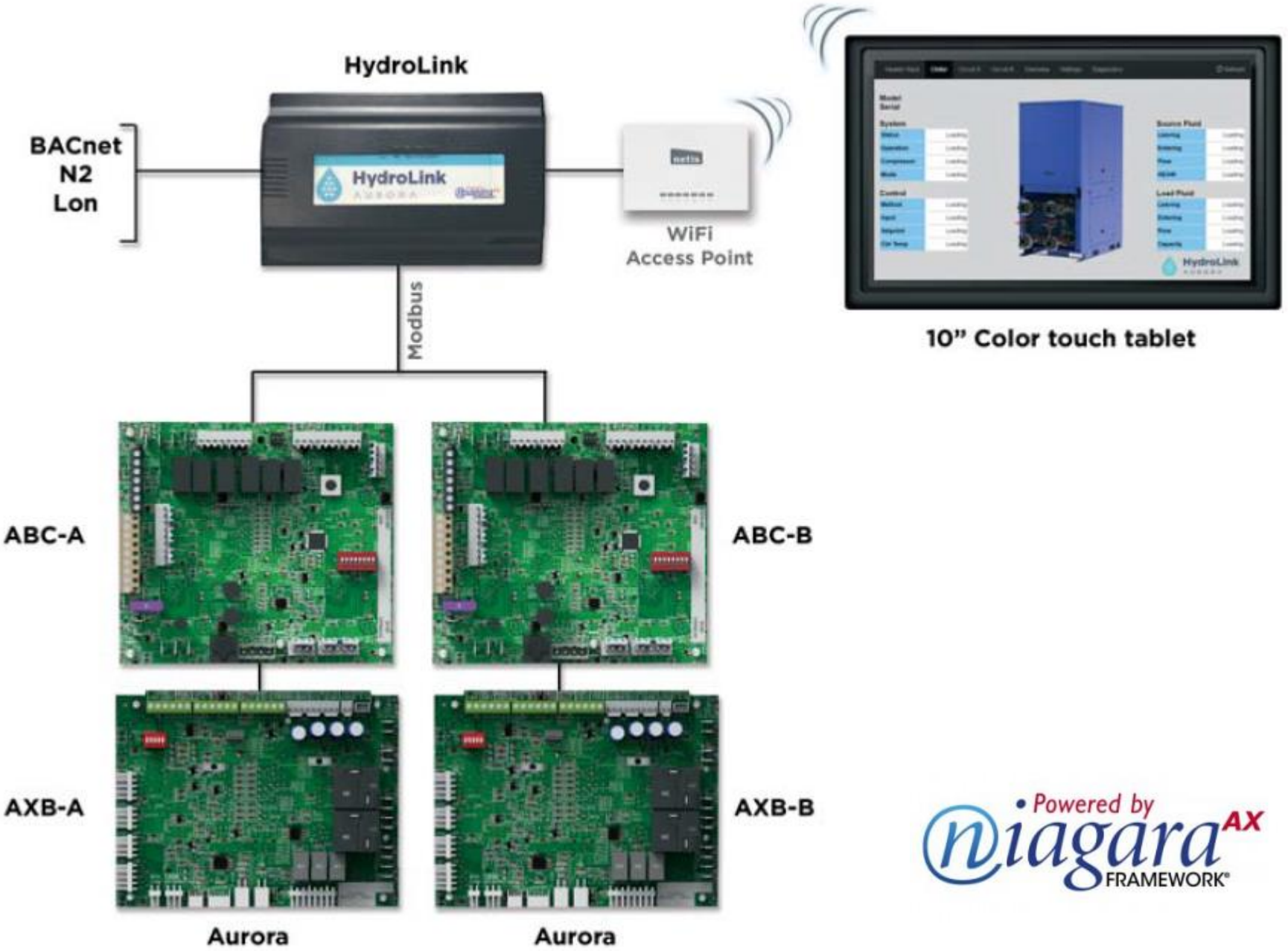
# HYDROLINK / AURORA CONTROLS UPDATE

- The HydroLink (NiagaraAX) Controller will provides supervisoy capability.

- The Aurora provides compressor and heat exchanger management.



# HYDROLINK/AURORA CONTROL




Powered by Niagara AX FRAMEWORK®

# CONTROL FEATURES

- Safeties: HP, LP, three levels of freeze protection and water temp alarms.
- Energy Monitoring – Amps and Watts for each compressor on every unit as standard.
- Refrigerant Monitoring – Suction and Liquid Line Temps, Suction and Discharge pressures, Superheat and Subcooling on each circuit.
- Performance Monitoring – entering and leaving water temperature and flow rate are measured with capacity calculation.

# CONTROLS FOR THE PIPE RACK

- Onboard Pipe Rack Control - Optional
  - Supports 4 Standard, 4 Reversing 6 standard and 6 dedicated types
  - 8 Mode operation
  - Local or Global temperature Sensing
  - 3-way valve control

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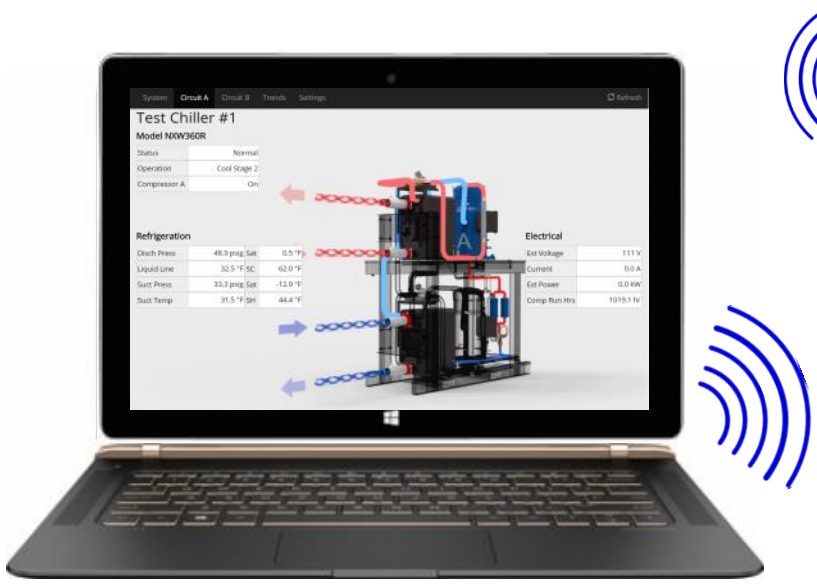
Commercial Solutions

# HYDROLINK WIRELESS CAPABILITY

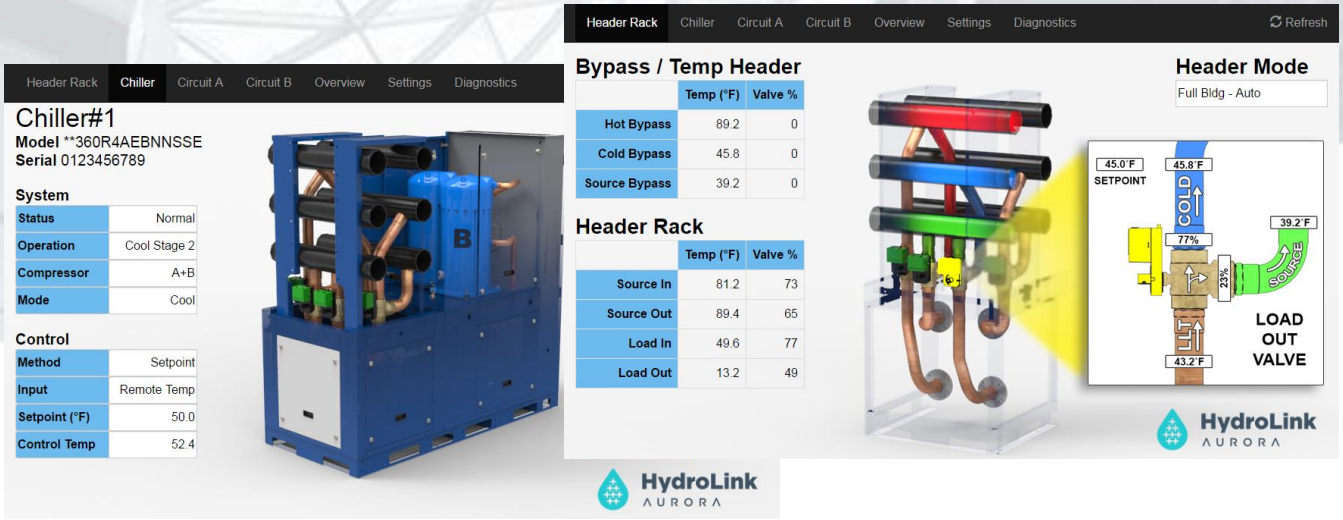
All units are WiFi capable for remote viewing on laptop, tablet or even smart phone.




# FRONT PANEL

10” Color
Touch Tablet

# CONTROL SCREENS




Powered by Niagara AX FRAMEWORK®

WaterFurnace® Commercial Solutions

# HEADER RACK SCREEN

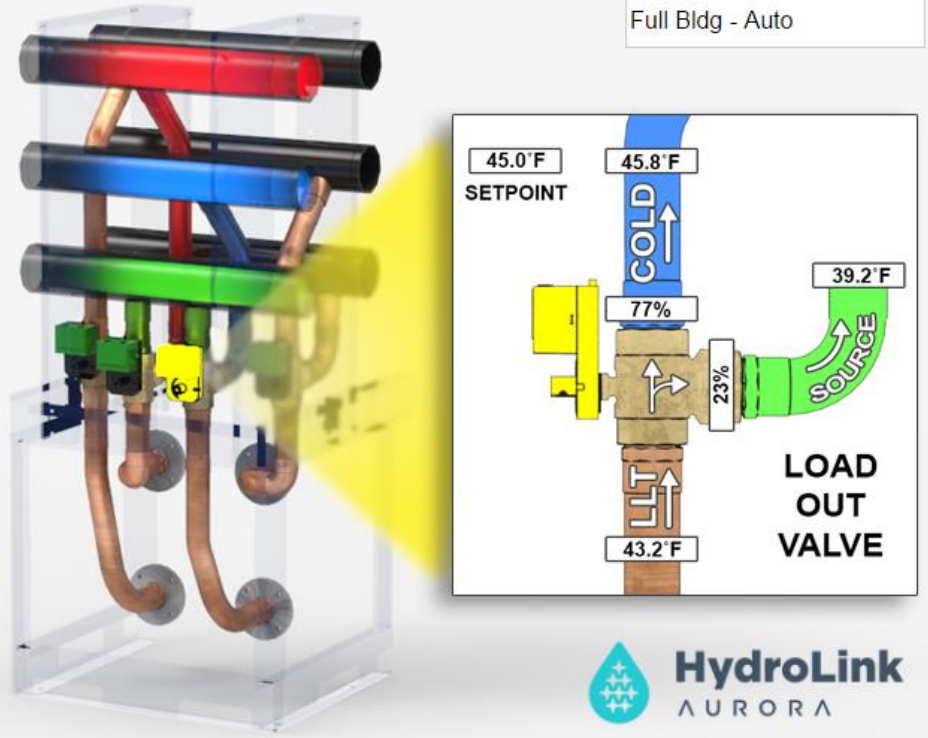
Header Rack | Chiller | Circuit A | Circuit B | Overview | Settings | Diagnostics | Refresh

## Bypass / Temp Header

| | Temp (°F) | Valve % |
|---|---|---|
| Hot Bypass | 89.2 | 0 |
| Cold Bypass | 45.8 | 0 |
| Source Bypass | 39.2 | 0 |

## Header Rack

| | Temp (°F) | Valve % |
|---|---|---|
| Source In | 81.2 | 73 |
| Source Out | 89.4 | 65 |
| Load In | 49.6 | 77 |
| Load Out | 13.2 | 49 |




## Header Mode

Full Bldg - Auto

HydroLink AURORA

# CHILLER SCREEN

Header Rack | **Chiller** | Circuit A | Circuit B | Overview | Settings | Diagnostics | Refresh

## Chiller#1

**Model** **360R4AEBNNSSE
**Serial** 0123456789

### System

| | |
|---|---|
| **Status** | Normal |
| **Operation** | Cool Stage 2 |
| **Compressor** | A+B |
| **Mode** | Cool |

### Control

| | |
|---|---|
| **Method** | Setpoint |
| **Input** | Remote Temp |
| **Setpoint (°F)** | 50.0 |
| **Control Temp** | 52.4 |


### Source Fluid

| | |
|---|---|
| **Leaving (°F)** | 60.7 |
| **Entering (°F)** | 42.0 |
| **Flow (gpm)** | N/A |
| **HE/HR (MBTU)** | N/A |

### Load Fluid

| | |
|---|---|
| **Leaving (°F)** | 39.0 |
| **Entering (°F)** | 62.1 |
| **Flow (gpm)** | N/A |
| **Capacity (MBTU)** | N/A |

HydroLink AURORA

# CIRCUIT A & B SCREEN

Header Rack | Chiller | **Circuit A** | Circuit B | Overview | Settings | Diagnostics | Refresh

## Chiller#1

**Model** **360R4AEBNNSSE
**Serial** 0123456789

### Circuit A

| | |
|---|---|
| **Status** | Normal |
| **Operation** | Cool Stage 2 |
| **Compressor A** | On |


### Refrigeration

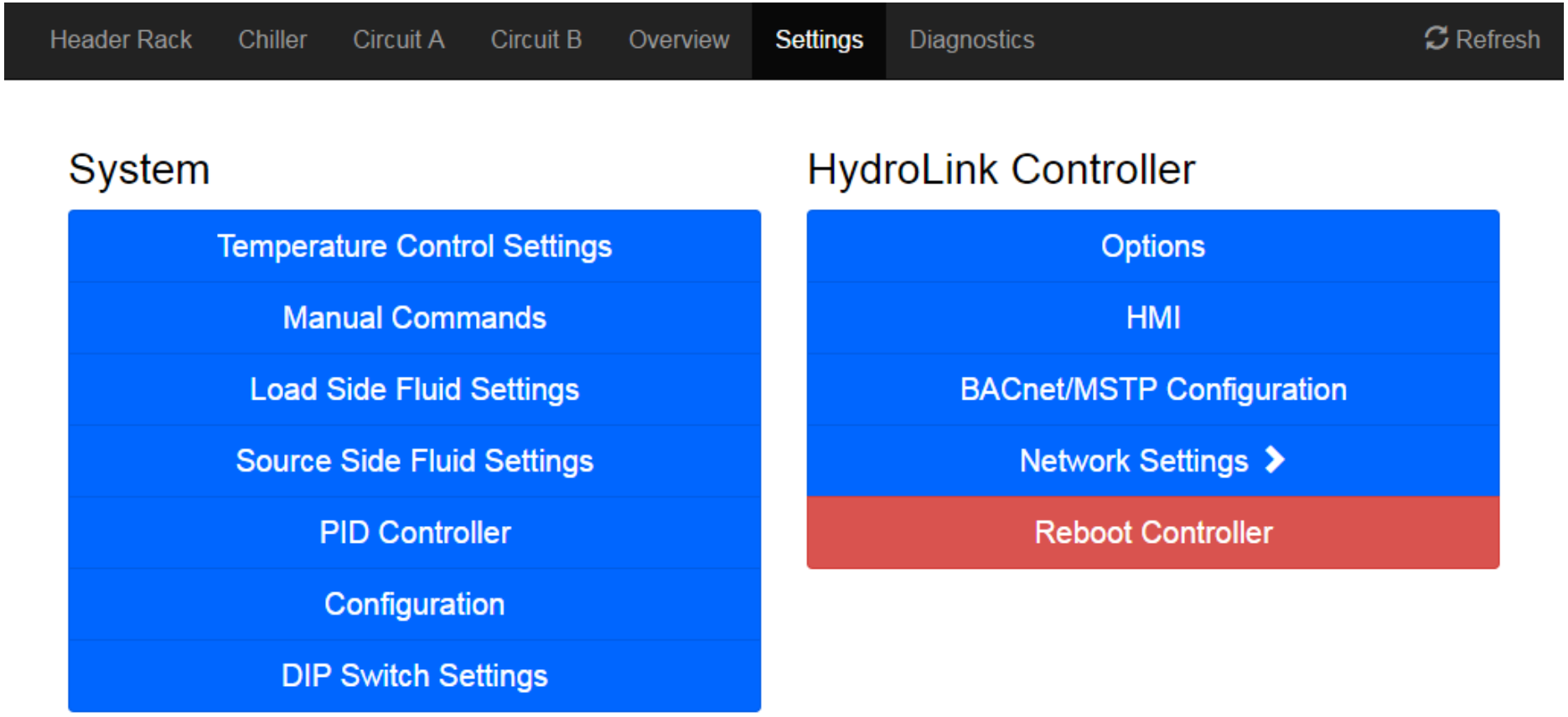
| | | | |
|---|---|---|---|
| **Disch Press (psig)** | 477.0 | **Sat (°F)** | 130.4 |
| **Liquid Line (°F)** | 130.6 | **SC (°F)** | 0.2 |
| **Suct Press (psig)** | 105.5 | **Sat (°F)** | 34.2 |
| **Suct Temp (°F)** | 60.9 | **SH (°F)** | 26.7 |

### Electrical

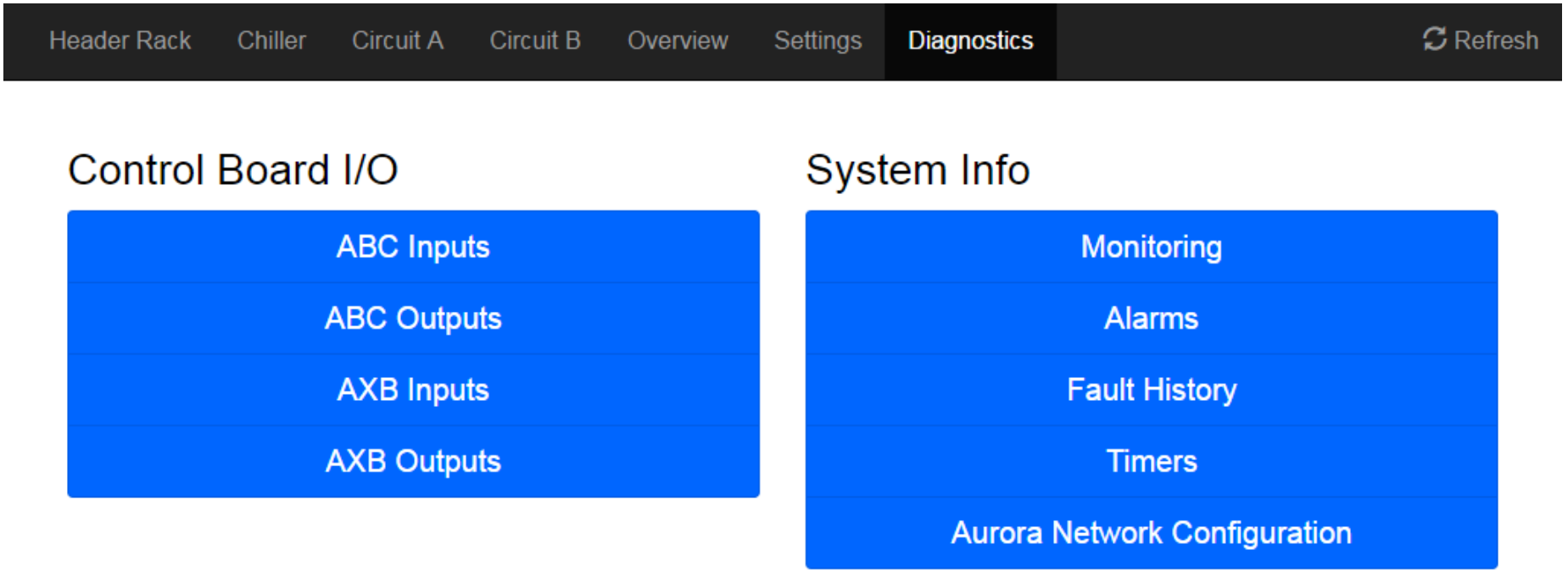
| | |
|---|---|
| **Current (A)** | 48.5 |
| **Est Power (kW)** | 33.3 |
| **Comp Run Hrs (hr)** | 3804.2 |

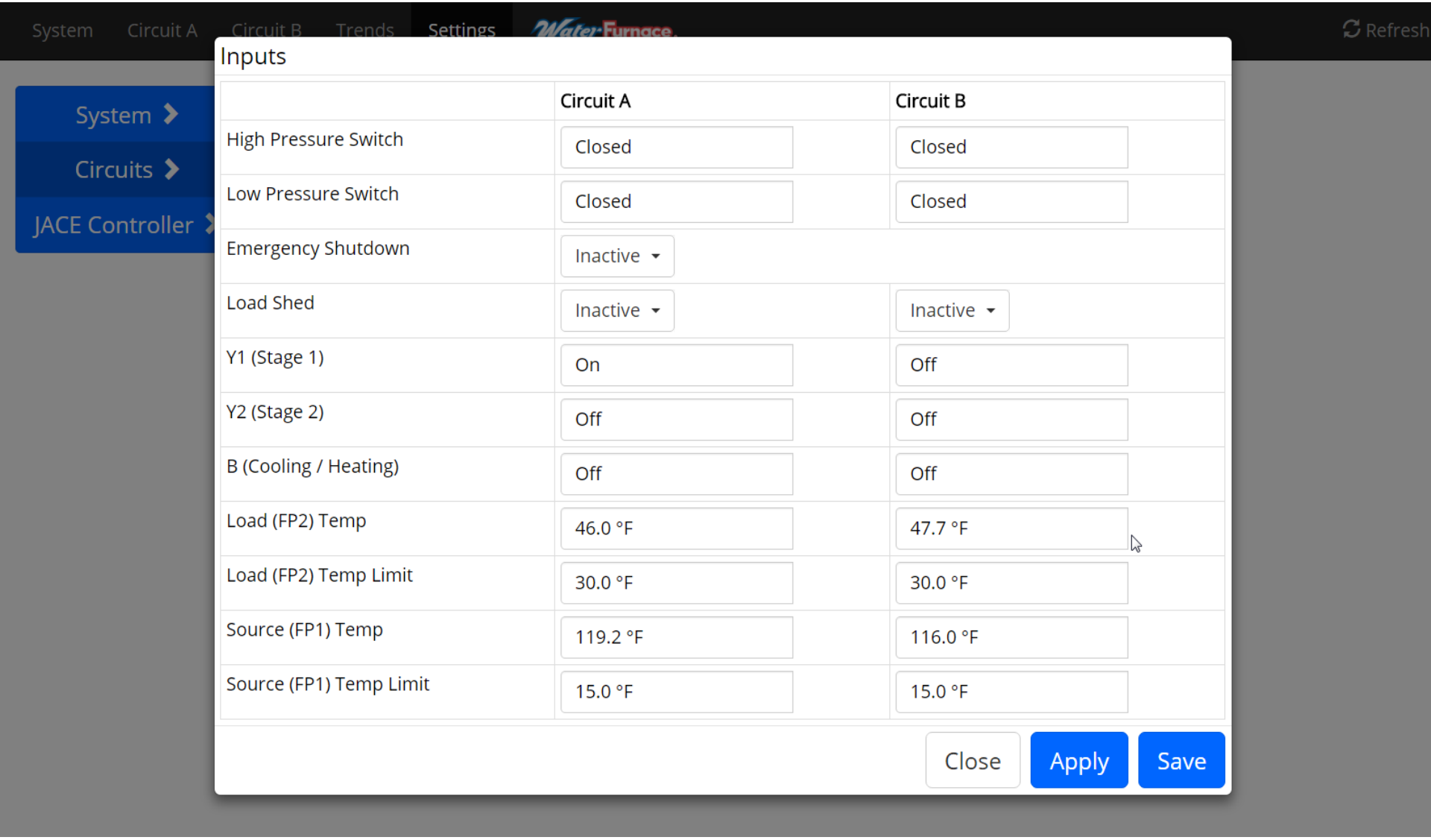
HydroLink AURORA

# SETTINGS SCREEN



# DIAGNOSTICS




System
Circuit A
Circuit B
Trends
Settings
Refresh
System
Circuits
JACE Controller
Inputs
Circuit A
Circuit B
High Pressure Switch
Closed
Closed
Low Pressure Switch
Closed
Closed
Emergency Shutdown
Inactive
Load Shed
Inactive
Inactive
Y1 (Stage 1)
On
Off
Y2 (Stage 2)
Off
Off
B (Cooling / Heating)
Off
Off
Load (FP2) Temp
46.0 °F
47.7 °F
Load (FP2) Temp Limit
30.0 °F
30.0 °F
Source (FP1) Temp
119.2 °F
116.0 °F
Source (FP1) Temp Limit
15.0 °F
15.0 °F
Close
Apply
Save

# HYDROLINK SUPERVISORY CONTROL


HydroLink Supervisory Control

Powered by Niagara AX FRAMEWORK®

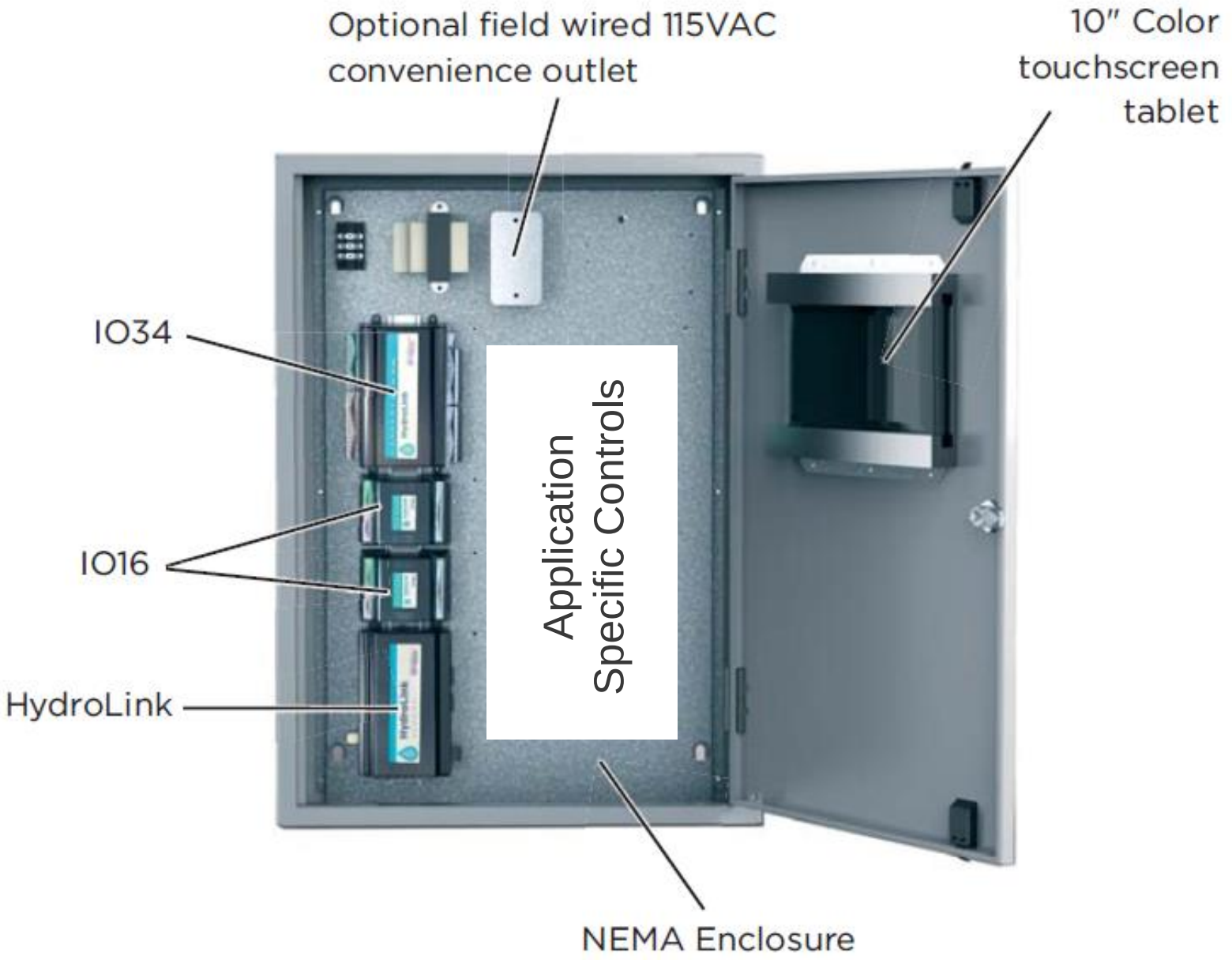
WaterFurnace® Commercial Solutions

# HYDROLINK SUPERVISORY CONTROL

- Supervisory/mechanical room duties
- In-house Custom Niagara Application Programming
- Includes mounted tablet display, JACE and enclosure.
- Other components can be added per job.


HydroLink Supervisory Control

# HYDROLINK SUPERVISOR OVERVIEW



# HYDROLINK SUPERVISORY APPLICATION

Thank You!

JACCO