Technology…Applied

IGSHPA Conference

October 2014
ClimateMaster leadership

Technology available today

Trilogy® of variable speed w/Q-Mode full-time water heating

vFlow™ – built-in variable water-flow

iGate™ – “connected” information gateway
1st to apply:

- 2-stage compressor for 25+ EER
- Tin-plated coils in geothermal products
- Stainless steel base pans
- Appliance grade cabinetry
- Double compressor isolation
TECHNOLOGY AVAILABLE TODAY
Smart and variable

- Compressors
- Pumps
- Motors
- Electronic Expansion valves
- Modulating water valves
- Smart sensors to measure flow and temperature
TECHNOLOGY AVAILABLE TODAY

• Smart communicating controls (boards) – at cost effective price points and update in the field

• Internet-Of-Things – cost effective connection to the internet

• Next generation heat exchangers – cost effective, higher efficiency

• High efficiency Storage tanks
TECHNOLOGY… APPLIED

iGate™

Your Smart Phone

Your Computer

Service Technician

iGate™ Smart Tank

Q-Mode®

Hot Water Tank

iGate™ Thermostat

PC Service Tool

Trilogy®

Variable Speed Fan

Variable-Speed Pump

vFlow™

EXM

Sensors

Switches

Variable-Speed Compressor

Electronic Service Valve

Two-Way Communication

One-Way Communication
Use of new technology
TECHNOLOGY… APPLIED

- Trilogy of Variable Speed
  - Inverter compressor
  - ECM fan motor
  - Internal loop pump
- Q-Mode
  - Space Cooling
  - Space Heating
  - Hot water during cooling
  - Full-Time hot water
  - Free cooling while heating water
- Internet-connected iGate communicating controls
- iGate Connect – Wi-Fi thermostat
- iGate Smart Tank
- vFlow internal variable water flow
Trilogy 45 Q-Mode Awards

2013 AHR Innovation Award
Category: Heating

Gold Winner - 2012 ACHR News Dealer and Design Award
Category: Residential
Trilogy 45 Q-Mode Awards

2013 R & D Award

L to R: Van Baxter, Sr. Engineer, Oakridge National Laboratory; Shawn Hern, Product Engineer, ClimateMaster, John Baily, VP of Sales, ClimateMaster, Wes Wostal, VP of Engineering, ClimateMaster

Industrial Research, R&D Magazine serves research scientists, engineers and technical staff at laboratories around the world, with timely, informative news and useful technical articles that broaden readers’ knowledge of the research and development industry and improve the quality of their work.
“Trilogy” of variable speed

Variable Speed
- Inverter variable speed compressor
- ECM variable speed fan
- ECM variable speed internal pump

Results
- 45 EER/5.1 COP* at part-load
- Best humidity and temperature control
- Capacity modulation down to 30%
  - 0930 model: 9K – 30K capacity
  - 1860 model: 18K – 60K capacity
- Superior hot water recovery / capacity
  - 25-30KBTUH output
- Significantly lower sound levels
- Delivers full capacity across the ENTIRE operating range of water temperatures (20 - 120° EWT)
TRILOGY OF VARIABLE SPEED Efficiency

- 45 EER ground loop cooling efficiency
- 5.1 COP ground loop heating efficiency
- >80% savings with Full Time hot water heating
- Free Cooling while simultaneously heating water
- >60% savings on loop pumping with vFlow

Total Watts (geo)

<table>
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<th>Trilogy 45 Variable</th>
<th>Traditional 2-Stage</th>
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<td>10,936</td>
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ISO 13652-1

4-ton system in St. Louis, MO; GeoDesigner
Full capacity across Op range Cooling
Full capacity across Op range Heating

Trilogy Capacity

- QE1860 max
- QE1860 min
- TT49 Full
- TT49 Part
Full capacity across Op range

Entering water temperature

20° EWT

120° EWT

Total Capacity

60.0 KBTUH
## PERFORMANCE DATA

**Paradigm shift**

### Table: Performance Data

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<th>EWT °F</th>
<th>DT</th>
<th>CFM/T</th>
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<th>SC</th>
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*Pressure drop is less than 1 ft*
Q-Mode Overview

• Patent pending

• 4 Modes of operation:
  – Space Cooling
  – Space Heating
  – Hot water while space cooling
  – Hot water operation only

• Hot water efficiency over 5.0 COP = Savings over 80% in hot water production vs electric water heater

• Free space cooling while heating water
  – Patent pending: Bypasses the loop – Transfers heat from the home to the hot-water tank
Q-Mode
Mode: Space Heating

Trilogy Variable GSHP Heating

Circuit Legend
- High Pressure Hot Gas
- High Pressure Hot Liquid
- Low Pressure Cool Liquid
- Low Pressure Cool Gas
- Unused Refrigerant Circuit
- Water (DHW & Loop)
Q-Mode
Mode: Space Cooling
Q-Mode
Mode: Cooling + Hot Water

Loop is COMPLETELY by-passed – delivering FREE COOLING when simultaneously heating water.
Q-Mode
Mode: Hot water only production
Trilogy 45 Q-Mode
New: iGate Smart Tank

- First smart (communicating) hot water storage tank = completely controlled by the Trilogy heat pump
- Provides 100% of homes hot water requirements at over 5.0 (500%) efficiency
- Communicating – includes *NEW* WXM board that communicates with the EXM.
- 2 sensors (top and bottom) monitor water temp settings – feeds data to EXM on Trilogy
- 2 Titanium heating elements; longer life and corrosion resistance
- Seamless tank impervious to rust corrosion
IGate
Web Enabled Communication Network

Access unit information from homeowner and dealer portal on the internet and on mobile devices.

Enables remote configuration and troubleshooting

• iGate (driven by EXM) monitors and communicates all major operations of the system to the iGate Connect thermostat, which pushes all the information to the internet

• Calculates: superheat, subcool, HE/HR, % capacity, pump watts, and fan static

• Access all information on connected PC/Laptop
• Homeowner access to system over the internet to program, alerts, away and other settings

• Dealer access to system over the internet to monitor, configure and diagnose from ANYWHERE

• Advanced email alerts BEFORE a problem occurs

• Reprogram boards on the jobsite using bootloader

• Set hot water temperature on thermostat

Update control software – in field
PC SERVICE TOOL

• Install program and connect to PC / laptop

• Connect directly to EXM board in Trilogy using cable

• Configure and diagnose from the tool

• Update software on EXM board from your PC
PC SERVICE TOOL

Configuration
Airflow, water-flow ($\Delta$Ts), unit capacity, thresholds, service mode operation from PC

Diagnostics
Superheat, Subcool, HE, HR, all flow, temperatures

Fault details (last 5)
ALL Conditions at the time of faults
iGate Contractor Portal
Monitor and diagnose online!
TRANQUILITY DIGITAL SPLITS

vFlow Variable Water Flow

Builds the major water circulation components right into the unit and Varies water flow to

- Minimize pump energy consumption
- Improve system reliability
- Save on installation time
- Make for a very clean and compact installation.

Water flow is automatically varied to maintain optimum system performance based on:

- Changes in unit capacity level (stage)
- Source water temperature
vFlow
Internal pump

- Grundfos variable speed pump
- Controlled by EXM to water $\Delta T$
- w/Expansion tank (145 psi)
- Built in water flow transducers electronically report
  - Water Flow (GPM)
  - Entering and leaving water temperature
  - Loop pressure in
- Reports are sent to the iGate Connect thermostat in plain English
- Reports are accessible through the Dealer portal
vFlow

Energy savings

Vs. Fixed speed flow controllers

Overall unit efficiency with pumping watts

vFlow operating cost savings: 60-80%

Over 2 EER increase in applied efficiency

3T @ 70deg EWT; Full load: 9 GPM; Part load 6 GPM
ClimateMaster has once again led the industry by applying cost effective technologies through

- Trilogy of variable speed
- Q-Mode full time hot water
- iGate connectivity and
- vFlow built in variable waterflow

To deliver HIGHER

- Efficiency
- Comfort
- Reliability
- Convenience
Thank You