VC Systems & Controls, Inc.

WARRANTY - 2015

VC Systems' Packaged Pumping Systems are warranted for a period of eighteen (18) months from manufacturing date or twelve (12) months from start up, whichever comes first. The warranty is limited to failure due to material defects or workmanship. For warranty to be in effect, the equipment must be installed, operated, serviced, and maintained with the manufacturers operation and maintenance manual and standard mechanical practice. The obligation of the manufacturer is limited to the repair or replacement of defective material or part.

VC System's is not responsible for normal labor charges, transportation, rigging, and handling. Damage resulting to normal wear parts or mechanical seals or damage from pumping product not covered. Further damages due to flooding, fire, wind, lightning, or acts of God are not covered. Damage that is result of maintenance neglect, misuse, or lack of normal service will not be covered. VC Systems disclaims any other warranty either implied or expressed and disclaims liability for property damage, loss of time, loss of income, loss of profit, or liability for liquidated or consequential damages. The maximum liability shall not exceed the cost of the authorized defective materials.

VC Systems extends no warranty, expressed or implied, beyond that outlined here, or those specifically agreed to, in writing, at the time of the order entry.

NOTES:

Motors
Motors covered under this warranty are required to be taken to a Baldor authorized motor shop for diagnosis for warranty claim. This includes catastrophic failures, vibration, or noise related to the motor.

Impellers (*VC ES Series Only*)
The impellers for VC ES Series pumps are warranted for 5 years against manufacturing defects, corrosion, or failure. This additional warranty is for parts only, same exclusions apply.

Exclusions:
This warranty does not cover mechanical seals, gauges, transportation, or labor costs for exchange, or installation of repaired or replaced materials. Final determination of warranty shall be made only by the factory upon return and inspection of returned material. No material is to be returned without a return material authorization (RMA) tag which may be obtained from contacting the factory.

UL CERTIFICATION

Packaged pumping systems by ***VC Systems & Controls, Inc.*** carry the UL Listing for Third Party Certification as a system built in conformance with it's intended use. This certification for packaged umping systems insures that the equipment meets OSHA and NEC requirements, and include a UL 508A Listed industrial control panel.

LISTED

PACKAGED PUMPING SYSTEMS
30BF-QCZJE185672

Systems & Controls, Inc.

CERTIFICATIONS & QUALIFICATIONS

Material/Product:
Domestic Water Booster Systems

Models:
1VC, 2VC, 3VC, 4VC, 5VC, 6VC

Certified Standards:
CA Health & Safety Code (AB1953)
Vermont Act 193
Weighted Average Lead Content <=0.25%
Federal Public Law 111-380
Maryland Chapter 407, House Bill 372
Louisiana House Bill 471
NSF / ANSI 372
NSF / ANSI 61-G

Third Party NSF Certified
by Truesdail Laboratories

UL Listed:
UL QCZJ - Packaged Pumping Systems
UL 508A Listed - Industrial Control Panels

Other Qualifications:
ASHRAE 90.1 Compliant
ARRA - Buy American Compliant
ASME Certified Welders
NIST Certified Testing Equipment
Massachusetts State Approval

8811 VENTURE COVE - TAMPA, FLORIDA 33637 - 800-881-3123

Refer to job specific cover page and details for specifications and certifications being provided.

Systems & Controls, Inc.

BUTTERFLY VALVE

Bray 31H Series

Construction:

- Body: Ductile Iron
- Disc: 316 Stainless Steel
  - Nylon Coated DI Optional
- Stem: 416 Stainless Steel
- Seat: EPDM
- Class 125/150, Full Lug

Specifications:

- Working Pressure: 250 PSI
- Temperature:-40 to 250 Deg F
- NSF / ANSI 61 Annex G Certified

	2”
	2.5”
	3”
	4”
	6”

Systems & Controls, Inc.

CHECK VALVE

CLA-VAL 81-12

Construction:

- Body: Epoxy Coated Ductile Iron
- Seat: EPDM
- Non-Slam / Silent Check
- Globe & Angle Configuration
- Flanged, Class 150 & 300

	2”
	2.5”
	3”
	4”
	6”

Specifications:

- Working Pressure: (Class 150) 240 PSI
- Working Pressure: (Class 300) 640 PSI
- Temperature:-20 to 250 Deg F
- NSF / ANSI 61 Annex G Certified

AMBER/BOOTH
A VMC Group Company

ACCESSORIES

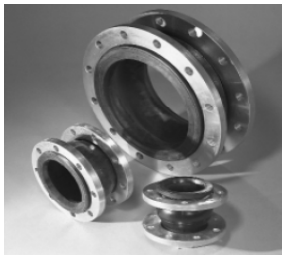
VIBRATION ISOLATOR
RUBBER-IN-SHEAR

	SIZE	MAX LOAD (LB)
☐	RVD-2-C	380
☐	RVD-2-D	700
☐	RVD-3-A	550
☐	RVD-3-B	930
☐	RVD-3-C	1540

NOTE: ISOLATORS ARE NOT SUPPLIED ON HIGH PRESSURE AND SPLIT BASE SYSTEMS

TCH TWIN CITY HOSE INC.

FLEXIBLE CONNECTOR
SINGLE SPHERE STYLE
ANSI FLANGED



	SIZE
☐	2"
☐	2.5"
☐	3"
☐	4"
☐	6"
☐	8"

EPDM BODY
250 DEGREE MAX
225 PSI MAX

NOTE: FLEX CONNECTORS ARE NOT SUPPLIED ON HIGH PRESSURE SYSTEMS

THERM OMEGA TECH, INC

THERMAL RELIEF VALVE
MODEL - 95-105

DATA:

- **THERMAL SAFETY VALVE FOR CASING PROTECTION**
- **MODULATING TYPE**
- **ALL 316 STAINLESS CONSTRUCTION**
- **95 - 105 DEG. F RANGE TO FULL OPEN**
- **400 PSI WORKING PRESSURE**
- **NON-ELECTRIC STYLE**
- **TWO PIECE CONSTRUCTION**
- **REDUNDANT SAFETY, ONE FOR EACH PUMP**

ACH550 Product Overview

Description

The ACH550 series is a microprocessor based Pulse Width Modulated (PWM) adjustable speed AC drive. The ACH550 drive takes advantage of sophisticated microprocessor control and advanced IGBT power switching technology to deliver high-performance control of AC motors for a wide range of HVAC applications.

With drives ranging from 1 to 550 HP, the ACH550 series features a universal full graphic interface that “speaks” to the operator in plain English phrases, greatly simplifying set-up, operation, and fault diagnosis. The ACH550 is also programmable in fourteen other languages.

Each ACH550 drive comes equipped with an extensive library of pre-programmed HVAC application macros which, at a touch of a button, allow rapid configuration of inputs, outputs, and performance parameters for specific HVAC applications to maximize convenience and minimize start-up time. The ACH550 series can handle the most demanding commercial applications in an efficient, dependable, and economic manner.

ACH550 Standard Features

- UL, cUL labeled and CE marked
- EMI/RFI Filter (1st Environment, Restricted Distribution)
- Start-Up Assistants
- Maintenance Assistants
- Diagnostic Assistants
- Real Time Clock
  - Includes Day, Date and Time
- Operator Panel Parameter Backup (read/write)
- Full Graphic and Multilingual Display for Operator Control, Parameter Set-Up and Operating
  - Data Display:
    - Output Frequency (Hz)
    - Speed (RPM)
    - Motor Current
    - Calculated % Motor Torque
    - Calculated Motor Power (kW)
    - DC Bus Voltage
    - Output Voltage
    - Heatsink Temperature
    - Elapsed Time Meter (reset-able)
    - KWh (reset-able)
    - Input / Output Terminal Monitor
    - PID Actual Value (Feedback) & Error
    - Fault Text
    - Warning Text
    - Three (3) Scalable Process Variable Displays
    - User Definable Engineering Units
- Two (2) Programmable Analog Inputs
- Six (6) Programmable Digital Inputs
- Two (2) Programmable Analog Outputs
- Up to six (6) Programmable Relay Outputs (Three (3) Standard)
- Adjustable Filters on Analog Inputs and Outputs
- Mathematical Functions on Analog Reference Signals
- All Control Inputs Isolated from Ground and Power
- Four (4) Resident Serial Communication Protocols
  - Johnson Controls N2
  - Siemens Building Technologies FLN (P1)
  - Modbus RTU
  - BACnet (MS/TP)
- Input Speed Signals
  - Current 0 (4) to 20 mA
  - Voltage 0 (2) to 10 VDC
  - Increase/Decrease Reference Contacts (Floating Point)
  - Serial Communications
- Start/Stop
  - 2 Wire (Dry Contact Closure)
  - 3 Wire (Momentary Contact)
  - Application of Input Power
  - Application of Reference Signal (PID Sleep/Wake-Up)
  - Serial Communications
- Start Functions
  - Ramp
  - Flying Start
  - Premagnetization on Start
  - Automatic Torque Boost
  - Automatic Torque Boost with Flying Start
  - Auto Restart (Reset) – Customer Selectable and Adjustable
- Stop Functions
  - Ramp or Coast to Stop
  - Emergency Stop
  - DC Braking / Hold at Stop
  - Flux Braking
- Accel/Decel
  - Two (2) sets of Independently Ramps
  - Linear or Adjustable ‘S’ Curve Accel/Decel Ramps
- HVAC Specific Application Macros
- Separate Safeties (2) and Run Permissive Inputs
- Damper Control
- Override Input (Fire Mode)
- Timer Functions
  - Four (4) Daily Start/Stop Time Periods
  - Four (4) Weekly Start/Stop Time Periods
  - Four Timers for Collecting Time Periods and Overrides
- Seven (7) Preset Speeds
- Supervision Functions
- Adjustable Current Limit
- Electronic Reverse
- Automatic Extended Power Loss Ride Through (Selectable)
- Programmable Maximum Frequency to 500 Hz
- PID Control
  - Two (2) Integral Independent Programmable PID Setpoint Controllers (Process and External)
  - External Selection between Two (2) Sets of Process
    - PID Controller Parameters
  - PID Sleep/Wake-Up
- Motor Control Features
  - Scalar (V/Hz) and Vector Modes of Motor Control
  - V/Hz Shapes
    - Linear
    - Squared
  - Energy Optimization
  - IR Compensation
  - Slip Compensation
  - Three (3) Critical Frequency Lockout Bands
- Preprogrammed Protection Circuits
  - Overcurrent
  - Short Circuit
  - Ground Fault
  - Overvoltage
  - Undervoltage
    - Input Phase Loss
  - Output Device (IGBT) Overtemperature
  - Adjustable Current Limit Regulator
  - UL508C approved Electronic Motor Overload (I^2T)
- Programmable Fault Functions for Protection Include
  - Loss of Analog Input
  - Panel Loss
  - External Fault
  - Motor Thermal Protection
  - Stall
  - Underload
  - Motor Phase Loss
  - Ground Fault
- 5% Input Impedance
  - Equivalent 5% Impedance with Internal Reactor(s)
  - Patented Swinging Choke Design for Superior Harmonic Mitigation (R1 to R4)

ACH550 Specifications

Input Connection

Input Voltage (U_1)	208/220/230/240 VAC 3-phase +/-10% 208/220/230/240 VAC 1-phase +/-10% 380/400/415/440/460/480 VAC 3-phase +/-10% 500/600 VAC 3-phase +/-10%
Frequency:	48 - 63 Hz
Line Limitations:	Max +/-3% of nominal phase to phase input voltage
Fundamental Power Factor (cos φ):	0.98 at nominal load
Connection:	U_1, V_1, W_1 (U_1, V_1, 1-phase)
Output (Motor) Connection	
Output Voltage:	0 to U_1, 3-phase symmetrical, U_2 at the field weakening point
Output Frequency:	-500 to 500 Hz
Frequency Resolution:	0.01 Hz
Continuous Output Current:	
Variable Torque:	1.0 * I_{2N} (Nominal rated output current, Variable Torque)
Short Term Overload Capacity:	
Variable Torque:	1.1 * I_{2N}, (1 min/10 min)
Peak Overload Capacity:	
Variable Torque:	1.35 * I_{2N}, (2 sec/1 min)
Base Motor Frequency Range:	10 to 500 Hz
Switching Frequency:	1, 4, 8 or 12 kHz
Acceleration Time:	0.1 to 1800 s
Deceleration Time:	0.1 to 1800 s
Efficiency:	0.98 at nominal power level
Short Circuit Withstand Rating:	100,000 AIC (UL) w/o fuses
Connection:	U_2, V_2, W_2
Enclosure	
Style:	UL (NEMA) Type 1, Type 12, or Type 3R UL Plenum Rated Type 1, Type 12
Agency Approval	
Listing and Compliance:	UL, cUL, CE

Ambient Conditions, Operation

Air Temperature:	0^0 to 40^0C (32^0 to 104^0F), above 40^0C the maximum output current is de-rated 1% for every additional 1^0C (up to 50^0C (122^0F)) maximum limit.
Relative Humidity:	5 to 95%, no condensation allowed, maximum relative humidity is 60% in the presence of corrosive gasses
Contamination Levels:	
IEC:	60721-3-1, 60721-3-2 and 60721-3-3
Chemical Gasses:	3C1 and 3C2
Solid Particles:	3S2
Installation Site Altitude:	0 to 1000 m (3300 ft) above sea level. At sites over 1000 m (3300 ft) above sea level, the maximum power is de-rated 1% for every additional 100 m (330 ft). If the installation site is higher than 2000 m (6600 ft) above sea level, please contact your local ABB distributor or representative for further information
Vibration:	Max 3.0 mm (0.12 in) 2 to 9 Hz, Max 10 m/s^2 (33 ft/s^2) 9 to 200 Hz sinusoidal

Ambient Conditions, Storage (in Protective Shipping Package)

Air Temperature:	-40^0 to 70^0C (-40^0 to 158^0F)
Relative Humidity:	Less than 95%, no condensation allowed
Vibration Tested to (IEC 60068-2-6):	In accordance with ISTA 1A and 1B specifications
Bump Tested to (IEC 60068-2-29):	Max 100 m/s^2 (330 ft/s^2) 11 ms (Tested 500 times each axis, each pole; 3000 times total)

Ambient Conditions, Transportation (in Protective Shipping Package)

Air Temperature:	-40^0 to 70^0C (-40^0 to 158^0F)
Relative Humidity:	Less than 95%, no condensation allowed
Atmospheric Pressure:	60 to 106 kPa (8.7 to 15.4 PSI)
Vibration Tested to (IEC 60068-2-6):	Max 3.0 mm (0.14 in) 2 to 9 Hz, Max 15 m/s^2 (49 ft/s^2) 9 to 200 Hz sinusoidal
Bump Tested to (IEC 60068-2-29):	Max 100 m/s^2 (330 ft/s^2) 11 ms (Tested 500 times each axis, each pole; 3000 times total)

Shock Tested to (IEC 60068-2-27)

R1: 76 cm (30 in) R2: 61 cm (24 in) R3: 46 cm (18 in) R4: 31 cm (12 in) R5 & 6: 25 cm (10 in)

ACH550 Specifications (continued)

Cooling Information

Cooling Method:	Integral fan(s)
Power Loss:	Approximately 3% of rated power

Analog Inputs

Quantity	Two (2) programmable
Voltage Reference:	0 (2) to 10 V, 250kOhm, single ended
Current Reference:	0 (4) to 20 mA, 100Ohm, single ended
Potentiometer:	10 VDC, 10 mA (1K to 10KOhms)
Input Updating Time	8 ms
Terminal Block Size	2.3mm^2 / 14AWG

Reference Power Supply

Reference Voltage	+10 VDC, 1% at 25^{0}C (77^{0}F)
Maximum Load	10 mA
Applicable Potentiometer	1 kOhm to 10 kOhm
Terminal Block Size	2.3mm^2 / 14AWG

Analog Outputs

Quantity	Two (2) programmable current outputs
Signal Level	0 (4) to 20 mA
Accuracy	+/- 1% full scale range at 25^{0}C (77^{0}F)
Maximum Load Impedance	500 Ohms
Output Updating Time	2 ms
Terminal Block Size	2.3mm^2 / 14AWG

Digital Inputs

Quantity	Six (6) programmable digital inputs
Isolation	Isolated as one group
Signal Level	24 VDC, (10V Logic 0)
Input Current	15 mA at 24 VDC
Input Updating Time:	4 ms
Terminal Block Size	2.3mm^2 / 14AWG

Internal Power Supply

Primary Use	Internal supply for digital inputs
Voltage:	+24 VDC, max 250 mA
Maximum Current:	250 mA
Protection:	Short circuit protected

Relay Outputs

Quantity	Three (3) programmable relay (Form C) outputs
Switching Capacity:	8 A at 24 VDC or 250 VAC, 0.4 A at 120 VDC
Max Continuous Current:	2A RMS
Contact Material:	Silver Cadmium Oxide (AgCdO)
Isolation Test Voltage	4 kVAC, 1 minute
Output Updating Time	12 ms
Terminal Block Size	2.3mm^2 / 14AWG

Protections

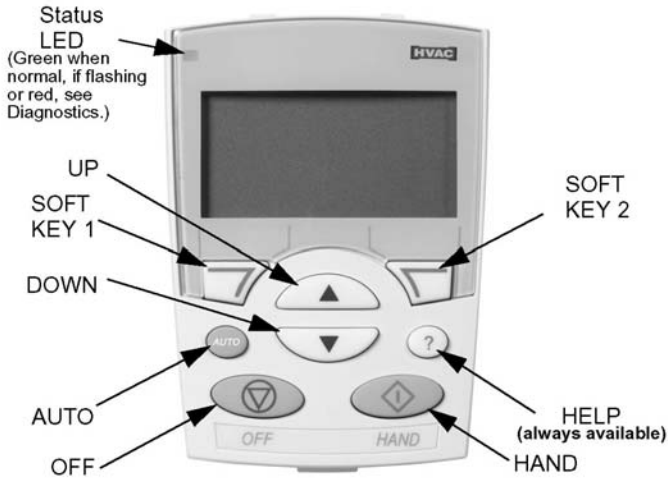
Single Phase	Protected (input & output)
Overcurrent Trip Limit:	3.5 x I_{2N} instantaneous
Adjustable Current Regulation Limit:	1.1 x I_{2N} (RMS) max.
Overvoltage Trip Limit:	1.30 x U_N
Undervoltage Trip Limit:	0.65 x U_N
Overtemperature (Heatsink):	+115°C (+239°F)
Auxiliary Voltage:	Short Circuit Protected
Ground Fault:	Protected
Short Circuit:	Protected
Microprocessor fault:	Protected
Motor Stall Protection:	Protected
Motor Overtemperature Protection (I^2t):	Protected
Input Power Loss of Phase:	Protected
Loss of Reference:	Protected
Short Circuit Current Rating:	100,000 RMS symmetrical Amperes
Input Line Impedance:	Swinging choke 5% equivalent R1-R6, 3% equivalent R8

U_1 = Input Voltage
U_2 = Output Voltage
P_N = Power – Normal Duty (HP)
U_N = Nominal Motor Voltage
f_N = Nominal Motor Frequency
I_{2N} = Nominal Motor Current – Normal Duty

Specifications are subject to change without notice. Please consult the factory when specifications are critical.

ACH550 Control Panel

The ACH550 Control Panel is a multifunction control panel with full graphic LCD display and multiple language capability. The control panel can be connected to and detached from the ACH550 at any time. The panel can be used to upload and copy parameters to other ACH550 drives.



Run Indication and Shaft Direction

Control Panel Display	Significance
Rotating arrow (clockwise or counterclockwise)	Drive is running and at set point Shaft direction is forward or reverse
Rotating arrow blinking	Drive is operating but not at setpoint
Stationary arrow	Drive is stopped

LED Indicators

The green LED indicates that the power is on and the drive is operating normally. The red LED indicates a fault. A blinking green LED indicates an alarm condition. A blinking red LED indicates a fault that requires power to be cycled off and on to reset the drive.

Fault Indications

The ACH550 Control Panel can display over 20 alarm and fault messages. The last fault and previous faults (1 to 9) are retained in memory. The last fault and previous faults (1 & 2) also record important diagnostic information to assist in troubleshooting. Most faults can be reset by pressing the RESET key (Soft Key 1).

Parameters

Application specific parameters are immediately accessible through a selection of start-up “Assistants”. A complete list of parameters is also available grouped by function in approximately 33 menu groups. One of the basic menu functions can be used to display the complete list of changed parameters.

Real Time Clock

The Operator Control Panel includes a real time clock which provides Day, Date and Time information, displayed in a choice of formats. The real time clock has a 10 year battery back up and provides time and date stamping of drive faults and other events. The clock is also used by the ACH550s internal timer functions, providing an integral time clock for start/stop control as well
as other control operations.

Control Modes

When the HAND key is pressed, the drive starts and pressing the UP/DOWN keys can modify the reference frequency. The HAND (keypad) control mode is indicated.

When the OFF key is pressed, the drive stops and the OFF control mode is indicated.

When the AUTO key is pressed, the AUTO control mode is indicated. The drive can be started and stopped using whichever remote start/stop command has been configured, a contact closure applied to the start/stop input, a serial communication command or a process feedback signal. In AUTO mode the drive speed is typically controlled by the external speed reference input or by the PID controller.

If the HAND key is pressed while the drive is running in the AUTO control mode, the drive continues to run without changing speed, but ceases to respond to external input or PID speed reference changes. (Bumpless transfer) Pressing the UP/DOWN keys can modify the reference frequency.

If the AUTO key is pressed while the drive is running in the HAND control mode and an external start command is present, the drive continues to run and follows the acceleration or deceleration control ramp to the speed set by the external input or PID speed reference. (Bumpless transfer)

Cable Connections

Terminal	Description	Note
U1, V1, W1	3~ power supply input	Use of 1~ supply requires 50% derate of output current and is applicable for 208 to 240 VAC operation only.
PE / GND	Protective Ground	Follow local rules for cable size.
U2, V2, W2	Power output to motor	
Uc+, Uc-	DC bus	
X1 1 to 18	Control Wiring	Low voltage control – Use shielded cable
X1 19 to 27	Control Wiring	Low voltage or 115VAC
X1 28 to 32	Serial Communications	Use shielded cable

Follow local codes for cable size. To avoid electromagnetic interference, use separate metallic conduits for input power wiring, motor wiring, control and communications wiring. Keep these four classes of wiring separated in situations where the wiring is not enclosed in metallic conduit. Also, keep 115VAC control wiring separated from low voltage control wiring and power wiring.

Use shielded cable for control wiring.

Ampacity is based on the use of 60 °C rated power cable up to 100 Amps (75 °C over 100 Amps).

Refer to the included tables for current ratings, fuse recommendations and maximum wire size capacities and tightening torques for the terminals. The ACH550 is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 480 V maximum. The ACH550 has an electronic motor protection feature that complies with the requirements of the National Electric Code (NEC). When this feature is selected and properly adjusted. Additional overload protection is not required unless more than one motor is connected to the drive or unless additional protection is required by applicable safety regulations.

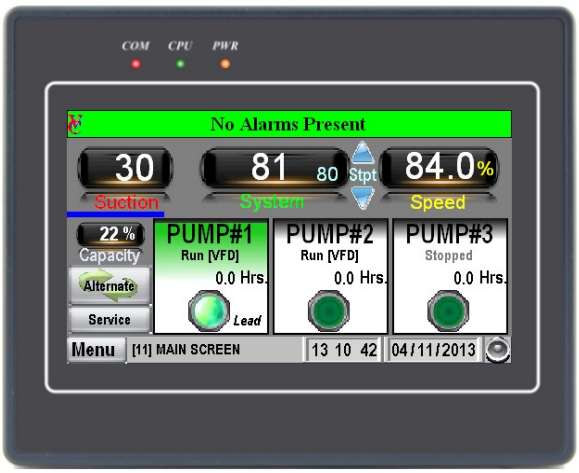
For CE installation requirements, see ABB publication CE-US-02 “CE Council Directives and Variable Speed Drives.” Contact your local ABB representative for specific IEC installation instructions.

ACH550 Control Terminals - Main I/O Terminal X1

X1	Identification	Description	
1	SCR	Terminal for signal cable screen. (Connected internally to chassis ground.)	
2	AI 1	Analog input channel 1, programmable. Resolution 0.1 % accuracy ±1 %. Default: 0 (4) - 20 mA (R_i = 500 Ω) (J1:AI1 ON) 0 (2) - 10 V (R_i = 200 kΩ) (J1:AI1 OFF) External reference	
3	AGND	Analog input common. (Connected internally to chassis ground through 1 MΩ)	
4	10 V	10 V/10 mA reference voltage output for analog input potentiometer, accuracy ±2 %.	
5	AI 2	Analog input channel 2, programmable. Resolution 0.1 % accuracy ±1 %. Default: 0 (4) - 20 mA (R_i = 500 Ω) (J1:AI2 ON) 0 (2) - 10 V (R_i = 200 kΩ) (J1:AI2 OFF) PID Feedback	
6	AGND	Analog input common. (Connected internally to chassis ground through 1 MΩ)	
7	AO1	Analog output channel 1, programmable. Default: 0 (4) - 20 mA (load < 500 Ω) Output frequency	
8	AO2	Analog output channel 2, programmable. Default: 0 (4) - 20 mA (load < 500 Ω) Output current	
9	AGND	Analog output common. Connected internally to chassis ground through 1 MΩ)	
10	24 V	Auxiliary voltage output 24 V DC / 250 mA (Reference to AGND). Short circuit protected.	
11	GND	Common for digital input (DI) return signals.	
12	DCOM	Digital input circuit common for all digital inputs (DIs).	
DI Configuration		To activate a digital input, there must be ≥+10 V (or ≤-10 V) between that input and DCOM. The 24 V may be provided by the ACH550 (X1:10) or by an external 12-24 V source of either polarity.	
13	DI 1	AUTO mode Start/Stop: Activation starts the drive	
14	DI 2	Not used	
15	DI 3	Constant speed 1: Activation selects constant speed 1	
16	DI 4	Start enable 1: Deactivation stops the drive.	
17	DI 5	Not used	
18	DI 6	Not used	
19	RO1C	Common	Relay output 1, programmable (Default: Ready - 19 connected to 21). 12 - 250 V AC / 30 V DC, 10 mA - 2 A
20	RO1A	Normally Closed (NC)	
21	RO1B	Normally Open (NO)	
22	RO2C	Common	Relay output 2, programmable (Default: Running - 22 connected to 24). 12 - 250 V AC / 30 V DC, 10 mA - 2 A
23	RO2A	Normally Closed (NC)	
24	RO2B	Normally Open (NO)	
25	RO3C	Common	Relay output 3, programmable (Default: Fault(-1) - 25 connected to 27). 12 - 250 V AC / 30 V DC, 10 mA - 2 A
26	RO3A	Normally Closed (NC)	
27	RO3B	Normally Open (NO)	
28	Screen	Terminal for signal cable screen. (Connected internally to chassis ground.)	
29	B	RS-485 Serial Communications Positive input connection	
30	A	RS-485 Serial Communications Negative input connection	
31	AGND	Analog input common. (Connected internally to chassis ground through 1 MΩ.)	
32	Screen	Terminal for signal cable screen. (Connected internally to chassis ground.)	

Notes: Digital input impedance 1.5 k Use multi-strand wire, size range: 20-16 AWG (0.5-1.5 mm^2) For fail-safe reasons, the Fault (-1) Relay signals a “Fault”, when the ACH550 is powered down.

VC Basic Control System Features



- 1-3 Equal Sized Variable Speed Pumps.
- Possible to add pumps in the future without reprogramming.
- Time of Day, Run Time, 1st On 1st Off Duty Cycle Alternation.
- Configurable for Suction pressure sensor or level switch. If suction switch input is not used, it can be configured for a system remote disable or generator lockout to limit number of pumps running under emergency power.
- Percent System Flow Capacity Indication
- Each alarm can be independently configured for behavior of pump shutdown, and reset modes.
-
- Advanced PID controls with "Kickstart" and "Stabilization" controls provide fast recovery upon starting the first pump.
- Power up restart delay and pressure recovery mode upon severe pressure loss. Safely and automatically refill empty pipes without water hammer.
- Interstage sequence timer provides better performance and fewer false starts and stops.
- Native MODBUS RTU RS485 2 Wire standard or Native BACNET MS/TP or IP via optional network module.
- 4.3" Color Touch Screen.
- Wide Screen Format provides with full interactive and animated graphics for a clear picture of the system operation.
- X-Y Plot of system operation. I plot sample per minute for up to 90 days.
- Event and History log with time date stamps and filter controls. Up to 1000 events.
- Parameter backup and restore utility. Quickly restore all settings to the last known working values at the touch of a button.
- Maintenance reminder message.

Basic Sequence

Controller can be configured for 1 to 3 pumps (variable or constant speed). This guide is universal for any number of pumps installed. All pressure and timer settings are user adjustable. Pressure is monitored and processed using an enhanced PID algorithm. The result of this calculation generates a speed signal that will modulate the pump speed to maintain a constant system pressure. Pumps are added and rejected based on the speed. The pump speed has a direct relationship to the flow capacity of the pump. This ultimately stages pumps on and off at the most effective points with minimal disturbance to the system pressure. It will inherently adapt as the pump impeller wears or clogs.

To prevent false starting and premature stopping of the pumps all timed sequences are interlocked. This means that a lag pump will not begin any start delay timers if the lead pump is not running. Similarly the lead pump stop delay timer will not begin timing out until the lag pump has stopped. By interlocking the pumps in this manner it is impossible for any pump to start or stop simultaneously under normal operating conditions. This also provides an orderly staging sequence upon power up or when returning to operation form a shutdown such as low suction. An interstage timer is also provided that allows the user to create a short time gap where pumps cannot be added or removed until the timer expires. This allows some setting time when pumps start and stop. The interstage timer is activated once with each pump start or stop event.

Typical operation example:
As the flow demand on the system increases the PID will speed the pump up to compensate. When the PID output reaches 100% (adjustable) the pump has achieved maximum capacity. Because we know that the pump is at full capacity we do not need to continue flowing beyond this point to induce a pump start via a pressure drop. Instead we begin the time delay (triggered by the PID output) for starting the next pump in line. When the next pump starts the PID will begin slowing as the next pump ramps up to speed and absorbs a portion of the system flow.

As the system flow reduces, the PID will begin reducing the pump speed to accommodate the reduction in system flow. When the speed drops below the minimum speed we know that the pump can no longer make enough pressure to open the check valve. At this point it is running at or near dead head. If we set the "PUMP REJECT SETPOINT" at this point then we can reject a pump and let the other pump(s) speed up to compensate for the change in the flow division. Obviously, speeding the pumps up again would cause the "PUMP REJECT SETPOINT" to be exceeded and therefore no additional pumps would be stopped.

Because the drives ramp the speed up and down slowly the PID will have time to adjust the speed of the drives as pumps are added or rejected from operation. For this reason there is little or no change in system pressure when pumps are added or removed.

Secondary control method
In the event a sudden pressure drop is detected and the pump has not already started from the primary sequence, the pressure drop would stage pumps on using traditional pressure based sequencing. These settings will be based on building minimums to allow more adjustable range on the primary system.

Lead pump Sleep Mode - Maximizing energy savings
A special sleep mode feature is provided that will constantly test for a zero flow condition. When no flow is detected, the lead pump will enter sleep mode, reducing the speed to 0% and effectively stopping the pump. Once the sleep mode has been entered, the pump will remain at 0 speed until a pressure drop is detected. In this way, the building static pressure can sustain small demands similar to the way hydro-pneumatic storage tanks work in many constant speed systems. If a pressure drop is detected, generally set several pounds below the normal operating pressure, the lead pump will ramp up and restore the system pressure. If the building demand is still low enough, the lead pump will return to sleep mode to conserve energy. Sleep mode is compatible on systems with or without hydro-pneumatic storage tanks. In some cases, a hydro-pneumatic storage tanks can be added to increase the amount of time the lead pump can remain in sleep mode.

One common problem with variable speed system is that they are very sluggish upon "waking" from a sleep state and that results in undesirable pressure fluctuations, often for 30 seconds or more. This is because in most cases, the first 50-70% of the pump speed has no impact on the system pressure. It simply requires that much speed to open the check valve and begin flowing water. While a PID is an excellent choice for speed control when everything is up and

running, it is blinded during the initial start of the lead pump. The PID will see no change as it speeds up the pump and react more aggressively to compensate. Then suddenly the pressure will spike as the pump crosses the threshold and begins flowing water. It's too late to do much at this point because the PID has ramped way beyond the speed required to make the minimum pressure and now has to reduce the speed to correct the huge error. If the water demand is very low, the excess pressure is often trapped and can even cause a high system pressure shutdown in severe cases. This problem requires a very careful and complex mathematical approach to resolve. VC Controls has developed a solution to this age old problem by creating a modified PID algorithm that transparently eliminates this overshoot. The software handles all the complex issues of getting the pump speed up to the threshold as quickly as mechanically possible, then seamlessly transitions into a full PID control scheme once the initial threshold has been overcome. In this way, the system response time is fast, accurate and produces no overshoot, even when starting into a closed valve (no flow) situation.

Pressure Recovery mode
When the pumps are offline for an extended period of time such as after a power outage or a system shutdown, the pressure can drop significantly and potentially create a dangerous hydraulic situation. If the pipes have drained and air has entered the system, simply restarting the system would cause the water to rush in at high velocities to refill the pipe. The very nature of the controller is to restore the pressure as quickly as possible. If the pipes are full, this is desirable, but if the pipes are empty, this can be disastrous. High velocities will eventually slam into the end of the pipe. Water does not compress like air and when it hits the end of the pipe, severe water hammer will occur. If the pipes are new and strong, everything may be fine, but over time as the pipes and fixtures weaken, this water hammer could cause serious damage and pipe breaks. This system has a pressure recovery mode feature that can be enabled to monitor the pressure while the pumps are off. In the event the pressure drops to unsafe levels, the recovery mode will refill the system slowly by ramping the lead pump speed up 1/2% per second until the system pressure returns to a normal operating range. In most cases the velocities will remain well under 1 foot per second until the pipes are refilled.

Alternation of pumps

The controller will change the order in which pumps start depending on programmed settings. This controller employs 3 different types of alternation than can be used independent or together as desired. Failed pumps are automatically removed from the sequence and a new alternation sequence is generated using the remaining pumps.

Duty Cycle (1st on 1st Off)
When pumps are added or removed from operation, this alternation mode will always attempt to remove the pump that has been operating the longest. In other words, the first pump started will be the first pump stopped. This alternation will generally keep a steady rotation through the pumps under normal circumstances. Actual run time is not controlled or balanced in this mode, but rather the objective of this alternator is to ensure a fresh pump is always used when adding and the pump that has been running longest is stopped first.

Time of Day Alternation
This alternation will automatically alternate the pumps at the preset time of day. This alternation causes a forced alternation regardless of any run time or stop/start cycles of the pumps. In the scenario where one pump runs continuously, a simple duty cycle alternation may never be induced. The Time of Day alternation will guarantee alternation one time per day minimum.

Excessive Run Time Alternation
Duty Cycle and Time of Day alternation cycle do little to balance the run time of the pumps but do a good job of making sure no pump gets all of the run time. In some cases it is desirable to limit the run time of a pump by switching to a new pump after the current pump has run for a preset time. This is very useful for system that have continuous and relatively stable demands that might cause a single pump to operate alone most of the time. Using the Run Time alternation would cause a new pump to be used every so often. The user may choose to set the run time so a new pump starts every 8 hours of actual continuous running time. This method of alternation can equalize the run time across the pumps if that is the desired goal.

Display Screens

The controller is provided with a 4.3” Wide Screen Format touch sensitive operator interface screen. Actual screens may vary slightly based on number of pumps or special features ordered, however this overview covers typical concepts and features provided with every system. The back light is automatically turned on when any part of the screen is pressed and will remain on for approximately 30 minutes if no buttons are pressed.

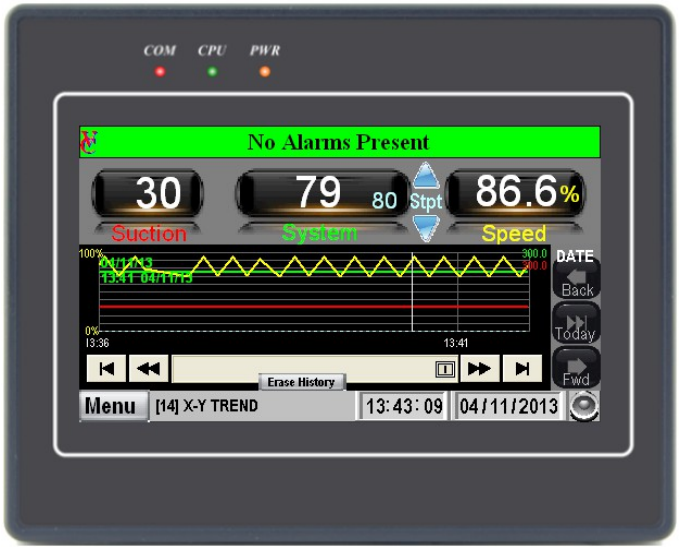
Under normal operation the display will show system operational data such as system and suction pressures or levels, PID output speed, pumps running, elapsed run time etc.

Many screens will have buttons that allow access to more help or information windows. Some icon such as the speaker in the bottom right hand corner are also buttons. Touching the speaker will mute the beeping sounds heard when pressing buttons. When muted, this icon changes to show if the sound is on or off. Screens that contain sensitive information such as configuration and parameter settings are protected by a password. Take some time to familiarize yourself with the screens available. The Menu button provides access to all major screens such as the main screen, the trending screen, the event log and parameters. Refer to “Controller Setup” for details on changing system settings.

Trending and Event Logs

This controller is provided with special data logging capabilities. These logs can be very useful when troubleshooting system operation.
All events such as pump alarms and actual pump run status are logged as they occur. The time that they occurred and the time that they ended are also recorded. Normal system events appear in a bold print as they occur and fade to a lighter color as they end. Active events can be double clicked to change the color so it is easy to identify new alarms that occur after current alarms are acknowledged. Alarm events will appear in the scrolling banner at the top of the screen that turns red when alarms exist, otherwise it will be green. All alarms will appear in the log as well. The first screen shows current alarms and events. A button on this screen opens a window that allows viewing of older events and alarms. To simplify viewing, alarms are indented and preceded with [!]. All events and alarms are backed up in EEPROM memory so they are retained even after a power loss.

In addition to the event log, a real time chart recorder is provided that will show the trend history of the system and suction pressures as well as the pump speed over the past 90 days or more. Each screen displays about 60 minutes of data and samples are approximately 1 minute apart.



Data from the current day can be accessed by simply using the arrow keys at the bottom of the chart recorder to scroll back and forth through time. You can skip from day to day using the DATE arrow buttons located near the right edge of the chart. Touching the chart will cause the date in the upper left corner of the chart to change to the date and time of the point you touched.

Event history logs and x-y data plots share EEPROM memory so both are retained through a loss of power. When the memory is full, the oldest data is deleted as new data comes in. The ample storage should be enough to track down issues even if they have spanned over long periods of time.

Alarms and Indicators and other controls

The system will monitor the supply and discharge pressures as well as drives for proper operation. In the event of abnormal operation the controller will illuminate a common alarm lamp and display a message indicating the source of the problem. All systems are provided with a form C common alarm “dry” contact for remote monitoring. This contact will change state in the event of any alarm including loss of power. The “Silence” button may be pressed to quiet the audible alarm while problems are resolved. The local and remote alarms will remain active until the condition ceases.

Note: Each alarm can be configured as needed to cause a pump shutdown, manual or automatic restart of pumps as well as manual or automatic reset of the alarm. The configuration is limited to factory authorized personnel due to the possible dangers involved in some scenarios and to ensure warranties are not void.

All systems are provided with the following alarms and messages. Additional alarms and messages are provided in addition to those listed here. Related information to each alarm is provided at the touchscreen for all alarms.

LOW SYSTEM ALARM
If the pressure (level) fails to rise above the low pressure (level) alarm setting within the alarm delay timer setting, this alarm will be engaged to notify an operator of the condition. This alarm will automatically reset when the condition ceases to exist. Possible causes include pumps left in the off position, motor overloads or drives tripped or clogged pump impellers.

HIGH SYSTEM ALARM
If the discharge pressure (level) rises above the alarm pressure (level) setting for the duration of the alarm delay timer, all pumps in “AUTO” will be stopped to prevent damage to system piping. Some possible causes include a failure of a pressure sensor or excessively high supply pressure to the system, improper PID tuning or manual operation of the pump above the high pressure alarm setting. A pressure display that is higher than the range printed on the sensor can indicate a sensor failure or wiring problem. Note that it is more common for a sensor to fail to negative pressure than a high pressure.

LOW SUCTION ALARM
The water source to the system should have some positive pressure (level). If this pressure (level) is lost there is danger of damage to the pump caused by a lack of water to properly lubricate the pump bearings. If the pressure (level) drops below the alarm pressure (level) setting for the duration of the time delay then the pumps in “AUTO” will be stopped. The pumps will automatically return to operation when the water supply pressure returns. The alarm must be manually reset.

Note: The suction alarm can be configured for a variety of sensors. Systems that pump from a pressurized city water main will generally have a pressure sensor, where as a system that is fed from a reservoir tank might use a level sensor or possibly a level switch. This controller can be configured for each of these possibilities.

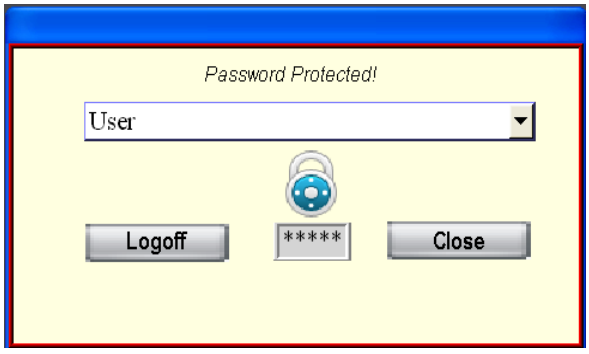
PUMP#[x] FAIL TO START (Where [x] = the pump number that has failed)
If any motor starter fails to engage when the controller calls it, this alarm is engaged to alert the operator that the system capacity is now reduced. System will continue to operate with the remaining pumps. This alarm can occur under drive failure, Drive Keypad switch in "Off" or if the drive has failed to start when called. On constant speed pumps or drive bypasses, this can also occur when an overload trips. The fail to start alarm must be manually reset.

Starting the system up for the first time

Each pump is provided with "HAND-OFF-AUTO" selector switches and run indication lamps. The "HAND" position is intended for attended use only. This mode will over-ride all alarms except the motor overload or drive trip. This can be useful for operating a system manually with failed components or for testing pump operation during startup. The "OFF" position will prevent a pump from being started in any mode. This is not a service lockout position. Always disable the power source to a pump before performing service. Failure to do so may result in personal injury or death. When preparing to start a system for the first time there are many things to be aware of. You need to familiarize your self with the controller, the required connections and the piping that the system is connected to. Never just walk up to a panel and throw the switch on and expect it to work. Doing so can cause serious damage to the system piping as well as the people around. Always assume all wires are live and practice safe electrical technique. Startup should only be performed by trained factory authorized personnel.

Controller Setup

All controller settings can be adjusted from the local control panel display only. Remote displays are not permitted to change parameters as this could cause a hazardous situation if a person is not present to monitor the reaction of the system to parameter changes.



To change parameters you will need to log in first to prevent unwanted tampering of the system parameters. Several security login levels are possible. Each parameter is assigned a security level. If your login level is not high enough, you will be prompted to log in at a higher level when a parameter is touched. It is not necessary to be logged in to view parameters, only to make changes
The panel is shipped with the password set as follows

User Levels allow changes to most parameters.
USER: 1111

Factory Representative Level can access all parameters except "Factory only" parameters and can view and change all passwords except Factory level.
Factory Reps are given their password by the factory.

Factory Level grants access to all parameters and all passwords. Factory level passwords are not published for obvious reasons.

To access the parameters simply touch the menu button and select the desired setup after you have logged in. You will be logged out automatically after 10 minutes, or if you press any of the logout buttons found in many locations. If you attempt to change a parameter that you do not have privileges to change, the login screen will pop up and prompt you to log in at a level that will permit changes. User passwords can be changed by logging in as a user with a higher or equal level or permissions. For example someone logging in as a Factory Representative would be able to change the password for "User" as the User is a lower level permission. Also note that there are 2 Factory levels that are for use only by factory authorized persons. It is suggested that new passwords be entered at startup to improve security. Simple default parameters are shown in the parameter lists below. A factory representative or factory person can change any password in the event all passwords are lost. For security reasons, the Factory passwords are not shown in this manual.

Touch the value of any parameter and a keypad will pop up to allow you to change that value.

Parameter Group [Screen ID]	Description *Value shown in brackets are factory default {###}*	Login Level Required	Field Setting
User [102.x]	[102.1] Wake Lead/Add Lag Dev. {-5} Seconds Setpoint {___} This delays the start of the lead pump. It is generally set to zero except when pressure swings are common when pumps are not running. [102.2] Delay on adding lag pumps {5} Seconds This delay is common to all lag pumps. The timer is not enabled until the interstage timer has expired, the next lag pump will then be available after this delay time. [102.3] Interstage Delay {5} Seconds This timer creates a gap between any start or stop pump action. By using this timer, it allows shorter start delays to be used for lag pumps as this timer will not require that the following pumps account for the ramp up and stabilization time.	USER	
User [103.x]	[103.1] Stop Delay {5} Seconds This only applies to lag pumps. Rejection happens based upon speed assuming pressure setpoint is satisfied. Since pump is ramped, there is no need to run ten minutes to ensure cooling time.	USER	

Parameter Group [Screen ID]	Description *Value shown in brackets are factory default {###}*	Login Level Required	Field Setting
User [104.x]	[104.1] Pump Overlap on Alternation {5} [104.2] Alternation Modes > 1st On 1st Off {On} > Time of Day {On} {Hr=22} > Run Time {On} {8 hrs} Refer to Alternation section of this sequence for details.	USER	
User [105.x]	Alarm Reset [105.1] Low Discharge Pressure {__} {__} [105.2] Alarm Delays - Seconds {5} {5}	USER	
User [106.x]	Alarm Reset [106.1] High Discharge Pressure {__} {__} [106.2] Alarm Delays - Seconds {5} {5}	USER	
User [107.x]	Alarm Reset [107.1] Low Suction Pressure {__} {__} [107.2] Alarm Delays - Seconds {5} {5}	USER	
User [108.x]	Alarm Reset [108.1] High Suction Pressure {300} {299} [108.2] Alarm Delays - Seconds {5} {5}	USER	
User [109.x]	[109.1] Exercise pumps that have not run for {24hrs} This feature will cause pumps that have no operated for a long time to be run for the time set in [102.2] [109.2] Exercise period {1min} This value is only used if the alarm is configured for automatic reset.	USER	
Factory[151.x] CRITICAL	PID Configuration 1 151.1 Proportional {0.04} [151.4] Sample Time {1x100ms} 151.2 Integral {0.09} [151.5] Min Out {50%} 151.3 Derivative {0.00} [151.6] Max Out {100%}	Factory	
Factory[152.x] CRITICAL	PID Configuration 2 152.1 Wake Dev {-5} [152.4] Reject Speed {70%} 152.2 Wake Speed {60%} [152.5] Default Speed {65%} 152.3 Wake Hold {5} [152.6] Stpt Limit {0 min} {300 max}		
Factory[153.x]	PID Configuration 2 152.1 Sleep Abort Deviation {-3} 152.2 Sleep Test Frequency {30sec} *Set to 0 to disable sleep mode* 152.3 Boost Deviation {3}		
Factory[154.x]	Scale System Sensor 152.1 Sensor Span {300} 152.2 Offset {0} *Adjust as needed to correct zero pressure reading*		
Factory[155.x]	Scale Supply Sensor 152.1 Sensor Type {Analog or Switch} 152.2 Sensor Span {300} 152.3 Offset {0} *Adjust as needed to correct zero pressure reading*		
Factory[156.x]	Scale Supply Sensor Low High 156.1 System {0} {2} 156.2 Suction {3} {0} Type Pump Stop Pump Restart Alarm Reset 0 No - Auto 1 No - Manual 2 Yes Manual Manual 3 Yes Auto Manual 4 Yes Auto Auto		

Parameter Group [Screen ID]	Description *Value shown in brackets are factory default {###}*	Login Level Required	Field Setting
Factory[157.x]	Configure Pumps 157.1 Qty Pump Installed {__} 157.2 Pump Fail to Start Delay {5} 157.3 Generator Limit Qty Pumps Run {0} *Note: Set = 0 for remote disable*		
Factory[158.x]	Pump ETM's 158.1 Pump#1 Elapsed Run Time {0hrs} 158.2 Pump#1 Elapsed Run Time {0hrs} 158.3 Pump#1 Elapsed Run Time {0hrs}		
Factory[159.x]	System Restart and Pressure Recovery 159.1 System Delay on Restart {25sec} 159.2 Enter Pressure Recovery Mode Below {__} *Set to 0 to disable*		
Factory[165.x]	Passwords 165.1 User 165.2 Factory Representative 165.3 Factory 1 & Factory 2.		
Factory[166.x]	Factory Representative Information Name, Cisty, State, Zip & Phone		
Factory[167.x]	Maintenance Reminder 167.1 Date for Popup Reminder {Month = 0} {Day=0} *Set to 0/0 to disable*		
Factory[168.x]	Backup Utility Use this utility to make a copy of PLC parameters in the color touch screen. If the PLC ever replaced or loses it's parameters, the screen can be used to restore them instantly.		
Factory[169.x]	PLC Information General information about PLC operation and installed program.		
Factory[170.x]	HMI Information General information about the color touchscreen operation and installed program as well as an adjustable field for changing the backlight timeout delay.		

Remote Monitoring and interface

The controller is provided with a network connection for MODBUS RTU via RS485 (2-wire) to monitor the system operation. The default network settings are 9600,N,8,1 address 5 but they can be changed from the color touch screen as needed. The PLC is equipped with two MODBUS ports. One is dedicated to the operator interface and the other is for customer BAS connection. The open customer port is labeled Port 3 and is a screw terminal connection that is clearly labeled with connection details. The PLC does not have terminating resistors. If they are required, they must be installed externally.

An **OPTIONAL** BACnet communications gateway is available preconfigured per the table below. BACnet MS/TP communication parameters can only be downloaded into the gateway by the factory. BACnet IP settings can be configured through the network port using a web browser.

Refer to the wiring diagram on the enclosure door for connection details.

The following data can be read over the MODBUS connection.

MODBUS ADDRESS	BACNET ADDRESS	DATA	NOTES
40001	AV0	SYSTEM PRESSURE OR LEVEL	
40002	AV1	SUCTION PRESSURE OR LEVEL	
40003	AV2	Not used	
40004	AV3	Not used	
40005	AV4	PUMP #1 STATUS WORD 0 = Stopped [Enabled] 1 = Running 3 = Failed [Offline] 4 = Not Installed or present	
40006	AV5	PUMP #2 STATUS WORD *See Pump#1 Status word for description*	
40007	AV6	PUMP #3 STATUS WORD *See Pump#1 Status word for description*	

MODBUS ADDRESS	BACNET ADDRESS	DATA	NOTES
40008	AV7	Not used	
40009	AV8	Not used	
40010	AV9	Not used	
40011	AV10	PUMP#1 ETM [HRS x100] *Example: 100hours will return a value of 1*	
40012	AV11	PUMP#2 ETM [HRS x100] *Example: 100hours will return a value of 1*	
40013	AV12	PUMP#3 ETM [HRS x100] *Example: 100hours will return a value of 1*	
40014	AV13	Not used	
40015	AV14	Not used	
40016	AV15	Not used	
40017	AV16	COMMON ALARM STATUS 0 = No alarms present 1 = Alarms Exist	
40018	AV17	Not used	
40019	AV18	SYSTEM SENSOR STATUS (Discharge pressure/level sensor) 0 = OK 1 = Short Circuit [*Failed*] 2 = Open Circuit [*Failed or not present*]	
40020	AV19	SUCTION SENSOR STATUS (Supply pressure/level sensor) Not used when suction sensor type is configured for "Switch Input" 0 = OK 1 = Short Circuit [*Failed*] 2 = Open Circuit [*Failed or not present*]	
40021	AV20	Not used	
40022	AV21	DISCHARGE PRESSURE/LEVEL ALARM 0 = No Alarm (Pressure/Level is normal) 1 = Low alarm (Pressure/Level is below normal limits) 2 = High Alarm (Pressure/Level is above normal limits)	
40023	AV22	SUCTION PRSSURE/LEVEL ALARM 0 = No Alarm (Pressure/Level is normal) 1 = Low alarm (Pressure/Level is below normal limits) 2 = High Alarm (Pressure/Level is above normal limits) *Note: Depending on user configuration this alarm status can be common to all pumps or reflect one or more pumps.*	
40024	AV23	EXTERNAL SYSTEM DISABLE Not used when suction sensor type is configured for "Switch Input" 0 = System enabled 1 = System disabled or limited due to generator power (wired input to panel) 2 = System is disabled due to remote lockout (wired input to panel) *Note: System can be user configured to limit system operation to any number of pumps or a complete shutdown under generator power.*	
40025	AV24	PID OUTPUT (Pump) SPEED IN PERCENT (0-100%)	
40026-40032	AV25-AV31	Unused - Reserved for future use.	

Note: A loss of communications indicates an active loss of power to the panel.