



Operation and Troubleshooting Manual

Model: 3 HP VSIM



All for dreams

M018141120000

Date: July 12, 2017



Table of Contents

Section 1 – Important Safety Information	1
Section 2 – About the 3 HP VSIM	3
Features	3
General Installation Instructions	4
Protect against Heat	4
Protect against Dirt	4
Protect against Moisture	4
Preparing the Motor / Control for Operation	4
Wiring the Motor / Control.....	5
Section 3 – Pump Control via the User Interface	8
Motor Quick Start Guide	8
Pause / Resume	9
Operation Modes	9
Standard Menu	10
Advanced Menu.....	11
Security Locked Menu	12
Programmed Flows	12
Manual Mode.....	13
Pause Mode	13
Watts	13
Vacuum Mode	13
Priming Output.....	14
Priming Time	14
Low Temperature Monitor	14
Acceleration Rate	14
Min Output.....	15
Max Output.....	15
Slave ID	15
Security Password.....	15
Controlling the Pump	16
Terminal and Function Tables	17
DIP Switch	17
Input Priority.....	18
Discrete Switch Inputs	18
Analog 0 – 10 VDC	19
Analog 4 – 20mA	19

Section 4 – Electrical Requirements	20
Input	20
Input Line Voltage	20
DC hipot	20
Input Line Current	20
Input Power Factor	20
Output	21
Software Protection	21
Voltage Protection	21
Over Voltage Protection	21
Under Voltage Protection	21
Low Line	21
Output Overpower Protection	21
Output Overcurrent Protection	22
Over Temperature Protection	22
Locked Rotor Protection	22
Hardware Protection	22
Fuse Protection	22
Inrush Protection	22
Mechanical Requirements	23
Connections	23
Environmental Requirements	23
Environmental Ranges	23
Environmental Protection	23
Section 5 – Agency	24
Safety	24
Electromagnetic Compatibility (EMC)	24
Section 6 – Troubleshooting	25
Basic Troubleshooting	25
Motor shaft is not spinning or runs abnormally	25
Motor rattles or makes excessive noise	25
General Troubleshooting	26
Section 7 – Default Settings	27
Section 8 – RPM vs Percentage Flow	28

Section 1 –Important Safety Information



- Do not lift the 3 HP VSIM by the electronic drive.
- Only trained and qualified professionals familiar with 3 HP VSIM motors should service the motor.
- Before connecting or disconnecting cables or other electrical connections, verify that the power to the system is removed. Failure to comply may cause serious damage to the motor or injury to personnel.
- Because of the risk of electric shock, only individuals thoroughly trained in the use of multimeters should conduct voltage tests.
- Never touch the metal contacts on the multimeter during a test.
- Always check testing equipment for proper operation before use.



Installation, operation, and maintenance must be performed by qualified personnel. Familiarization with and adherence to the National Electrical Code (NEC) and National Fire Protection Association (NFPA) standards and to local codes are required. It is important to observe safety precautions to protect personnel from possible injury. Personnel should be instructed for handling each of the following:

- Do not connect 460V power to this 230VAC product.
- Insulate all connections carefully to prevent grounding or short circuits. Reinstall all conduit and terminal box covers.
- To avoid overheating or loss of performance, voltage to the motor control unit must be within plus or minus 10% of the nameplate voltage.
- Make sure the unit is electrically grounded and that proper electrical installation, wiring, and controls are used consistent with local and national electric codes. Refer to **NEC Handbook and NFPA No. 70**. Employ qualified electricians.
- Code requirements differ from state to state. Install equipment using qualified electricians in accordance with the applicable codes and ordinances in your area and in accordance with NEC. All electrical connections should be made and maintained by a qualified or licensed electrician.

 WARNING

- Make sure there are no unusual noises or vibrations when the motor is running.
- Avoid contact with energized circuits and rotating parts.
- Provide proper safeguards for personnel against rotating parts.
- All aspects of the installation must conform to the applicable requirements of the NEC, including **Article 430 (Motor Circuits and Controllers)**, as well as all local codes.
- Always disconnect electrical power at the fuse box or circuit breaker panel before handling electrical connections or performing maintenance on this unit. Allow the motor to come to a complete stop and wait four (4) minutes. This allows the capacitors to discharge any residual voltage for safety.
- Double-check to make sure that power is removed and that it cannot be turned on while you are working on the equipment.
- A poor electrical connection can overheat and cause terminal and/or terminal board failures. Examine the connections carefully for any signs of physical deterioration or loose fit to the motor terminal block.
- Care must be taken to assure connections are made to the proper terminals and adequate electrical clearances are maintained.
- The control unit on the motor contains potentially hazardous voltage.

 CAUTION

- Wear safety glasses to inspect the equipment while it is running or while working on equipment, especially if cover plates are removed.

NOTICE

The motor and control unit are assembled and calibrated as a set. The motor and control are not separately serviceable.

- Do not perform an AC high potential dielectric (high pot) test. An AC high pot test can damage the control.
- To prevent permanent damage to the unit, **only apply nameplate voltage**.
- Do not strike the motor shaft with a hammer or other tool as this may damage the bearings.
- Voltage symbols vary among different multimeters and may be displayed as VAC, AC, V, or a V beneath a wavy line. Select the correct symbol and set the multimeter to the voltage closest to but higher than the voltage you are measuring.
- Read all instructions thoroughly and be familiar with the equipment before installing or working on it.
- The 3 HP VSIM motor is properly packaged for shipment and storage and should be kept in a clean and dry indoor area.

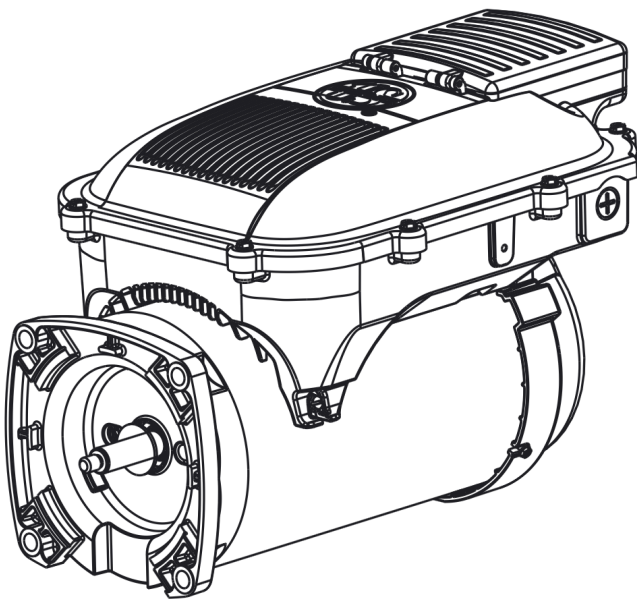
Section 2 –About the 3 HP VSIM

The Affinity® 3 HP Variable Speed Induction Motor (VSIM) is a premium efficient product which includes a fully integrated motor, control, and user interface. The product provides tremendous programming flexibility and speed range capability. The Affinity® 3 HP VSIM allows for compliance with new variable speed energy legislation. It is also designed to communicate and operate with a variety of external system controls, in addition to the on-board User Interface.

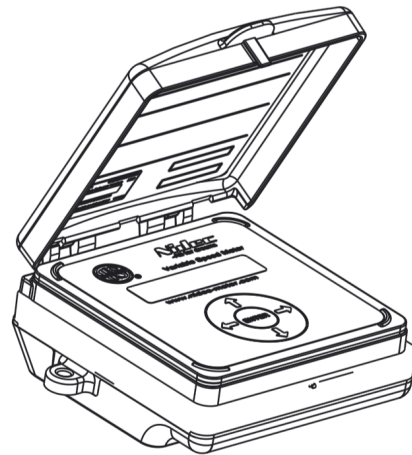
Features

- Horsepower: Up to 3.0 total horsepower
- Voltage/Hertz: Single Phase power input. 230 Volts AC/ 60 or 50 Hz
- Speed Range: 500 to 4000 RPM capability [500 to 3450 RPM by default]
- Control Inputs: 0-10V, 4-20 mA, 4 Discrete Inputs
- Enclosure: Totally enclosed fan cooled for long field life in outdoor environmental conditions
- Fully functional, easy to operate User Interface
- UL 1081, UL 60730-1A & CE Agency recognition
- Onboard power factor correction
- Designed for quiet operation
- Fully Integrated: Designed for simple “Drop-in” installation with no complex wiring.

Affinity® 3 HP VSIM



Easy to Operate User Interface



General Installation Instructions

Follow these instructions to prolong the life of the pump motor / control. Install the product on a secure and level platform or base such as a concrete pad.

Protect against Heat

- Shade the motor / control from the sun.
- Provide ample cross ventilation.
- Protect the motor / control from lint, etc., that can clog the ventilation openings.

Protect against Dirt

- Keep the motor / control and the surrounding area clean.
- Avoid sweeping or stirring dust near the motor / control while it is running.
- Avoid storing or spilling dry chemicals near the motor / control.

Protect against Moisture

- Provide protection from rain, snow, etc.
- Do not wrap the motor / control with plastic or other air tight materials.
- Locate the motor / control on a slight elevation so that water does not run or puddle nearby.
- Avoid splashing water on or near the motor / control.
- Repair leaky pipe joints or pump seals promptly.

Preparing the Motor / Control for Operation

The Affinity® 3 HP VSIM has been functionally tested before shipment. Most pool installations already have the power in conduit. However, on-site installation requirements and electrical codes vary and are the responsibility of the installer. The motor / control must be wired before operating. **Note:** A power cord is not provided.

You will need the following tools.

- 5/16 socket or nut driver
- Regular screwdriver
- #2 Phillips screwdriver

Wiring the Motor / Control

To wire the motor / control, follow the steps listed below.

1. Remove the eight (8) #10-32 Hex Serrated Washer HD screws securing the cover. Set the cover aside, being careful not to disconnect the control unit cord from the UI interface board. (Refer to **Figure 1**.)
2. Remove the three (3) Phillips head screws securing the high voltage cover on the AC input terminal block and set the cover aside. (Refer to **Figure 1**.)

WARNING

- Always disconnect electrical power at the fuse box or circuit breaker panel before handling electrical connections or performing maintenance on this unit. Allow the motor to come to a complete stop and wait four (4) minutes. This allows the capacitors to discharge any residual voltage for safety.
- The control unit on the motor contains potentially hazardous voltage.

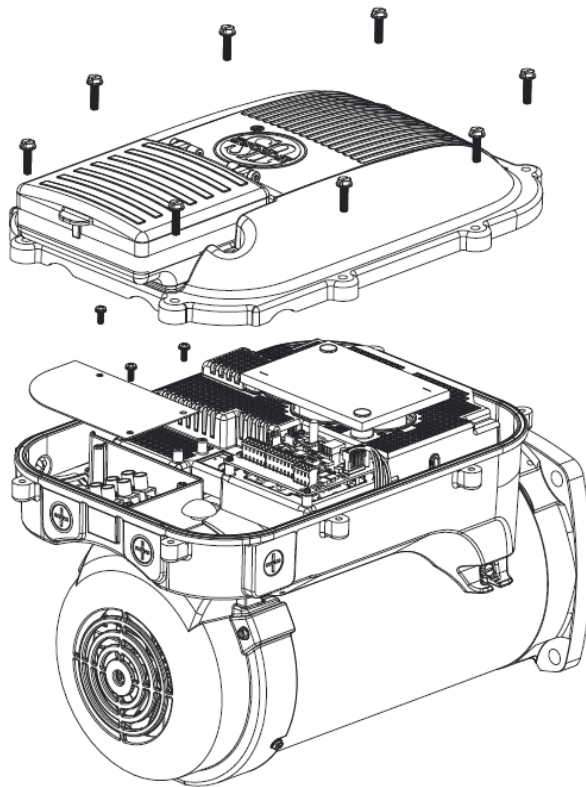


Figure 1

3. Disconnect and remove the Factory Test Leads. (Refer to **Figure 2**.) **Note:** When wiring the motor, if another conduit hole is required for the installation, swap the conduit plug you removed and secure the plug into the conduit hole you will not be using.

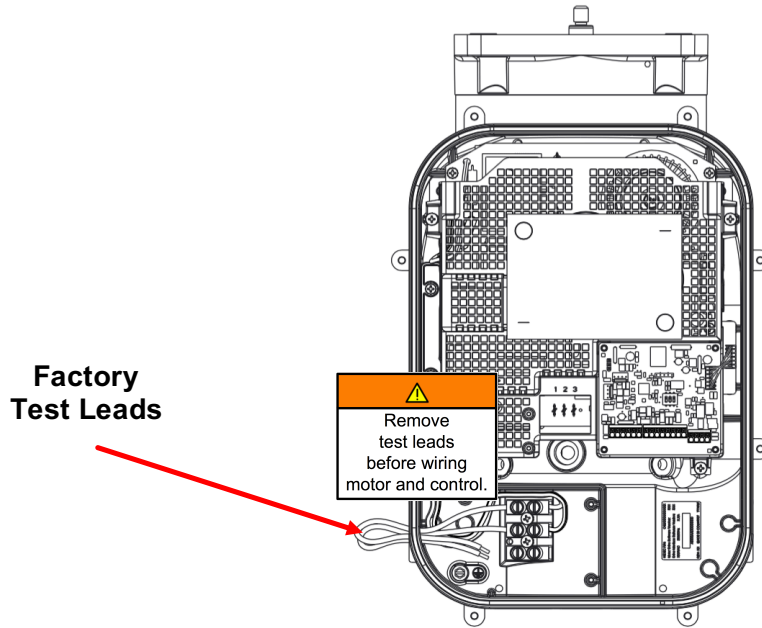


Figure 2

4. Insert the power cord and use a water tight connector to seal the conduit hole (1/2" NPT thread).
5. Install the GND and AC input wires as specified on the motor nameplate. You must connect L1, L2, and GND in the wiring compartment correctly and securely. (Refer to **Figure 3.**)

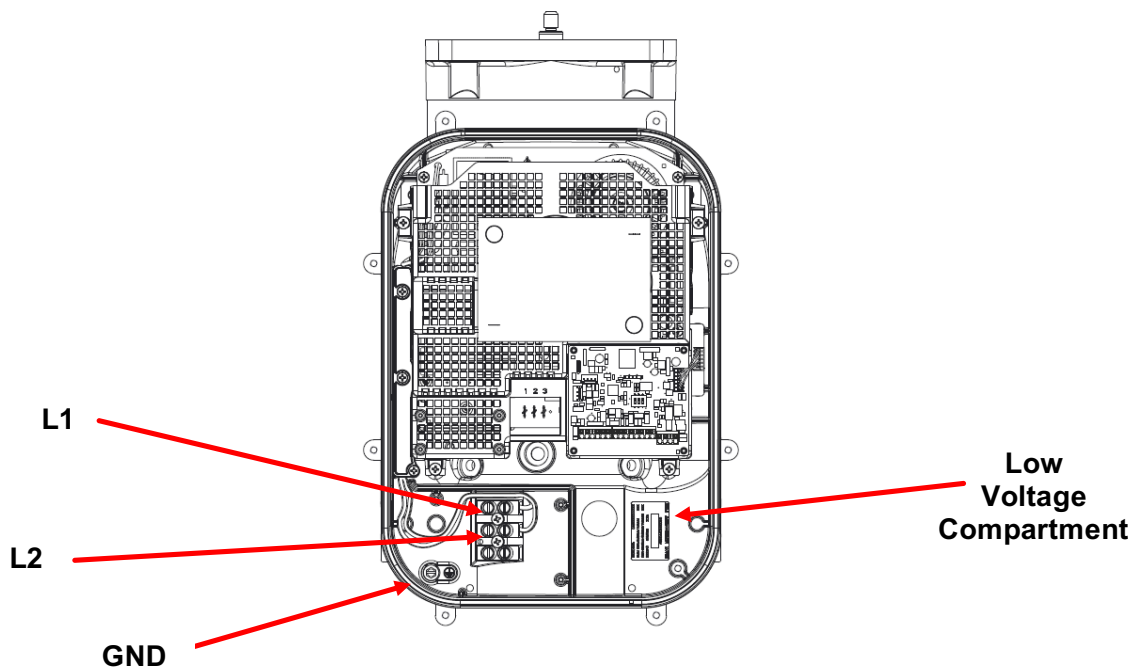


Figure 3

6. Secure the high voltage cover with the three (3) Phillips head screws.
7. Set the control cover back in place, taking care to coil the User Interface cable into the low voltage compartment.
8. Install the eight (8) #10-32 Hex Serrated Washer HD screws and ensure all are tightened securely before applying power.

Section 3 – Pump Control via the User Interface

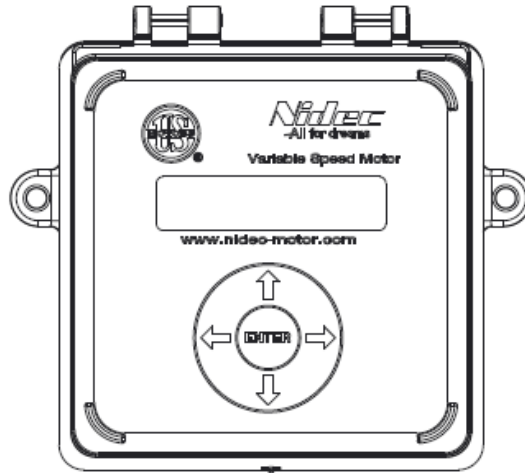


Figure 4

Motor Quick Start Guide

The Affinity® 3 HP VSIM comes with a Motor Quick Start Guide on the inside cover of the User Interface. Refer to it for the latest instructions. If the guide is missing, use the following.

Motor Quick Start Guide

To use factory default settings, simply set the Time (see below).

To change a value, press **Enter** to start editing, $\uparrow$ $\downarrow$ to change values, $\leftarrow$ $\rightarrow$ to navigate cells, and **Enter** to accept new settings.

Set Time

1. Press $\downarrow$ until the Set Time screen is displayed
2. Press **Enter** to activate time setting
3. After editing time, press **Enter** to accept new time

Set Flow Rate
(or, skip to use the default settings)

1. Use $\downarrow$ to select flow rate 1 then **Enter** to edit
2. After editing the setting, press **Enter** to accept flow rate
3. Use $\downarrow$ to select flow rate start time. Then **Enter** to edit
4. After editing time, press **Enter** to accept new start time
5. Repeat steps 1, 2, 3, and 4 for each flow rate setting

Hold **Enter** for 3 seconds while running to pause current timed flow
 Hold **Enter** for 3 seconds while time flow is paused to resume
 To vacuum, hold $\leftarrow$ and $\rightarrow$ simultaneously for 3 seconds, then press **Enter**
 To cancel vacuuming, hold $\leftarrow$ and $\rightarrow$ simultaneously for 3 seconds.

Pause / Resume

Your Affinity® 3 HP VSIM runs programmed flows throughout the day. To pause the current cycle, press and hold ENTER for three (3) seconds. To resume normal operation, press and hold ENTER for three (3) seconds again.

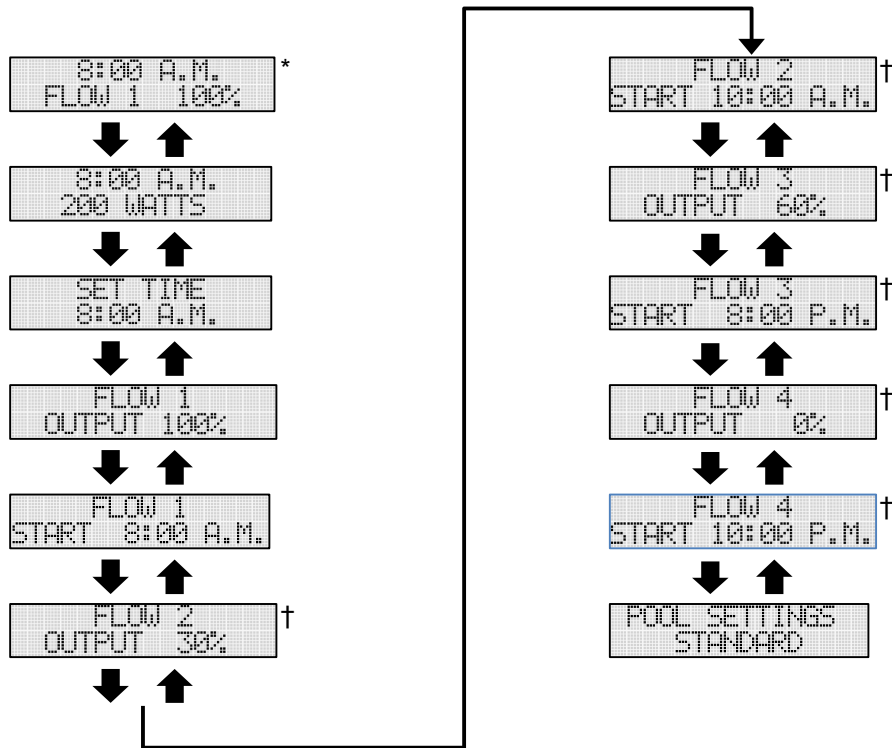
Operation Modes

The Affinity® User Interface can operate in one three modes – STANDARD, ADVANCED, and SECURITY LOCKED. Refer to the descriptions below for an overview of each mode.

Mode	Description
STANDARD	The POOL SETTINGS feature has two values – STANDARD and ADVANCED. Refer to the charts on the following pages for available settings. Most functions of the pump are accessible, including the ability to put the User Interface into ADVANCED or SECURITY LOCKED modes. See page 10 for more details.
ADVANCED	ADVANCED mode allows you to add program flows, adjust outputs and password protect your Affinity® 3 HP VSIM, along with other advanced settings. See page 11 for more details. You can switch the pool pump into STANDARD or SECURITY LOCKED modes and set other options available from the POOL SETTINGS screen.
SECURITY LOCKED	SECURITY LOCKED mode allows you to view the current flow settings, but does not allow you to make changes. To change settings, you must enter your 4-digit password to unlock the mode. You can then move back into either STANDARD or ADVANCED mode and adjust settings. See page 12 for more details.

Standard Menu

For the basics of key navigation, refer to the Motor Quick Start Guide on the inside cover of the User Interface or to **page 8** in this manual.

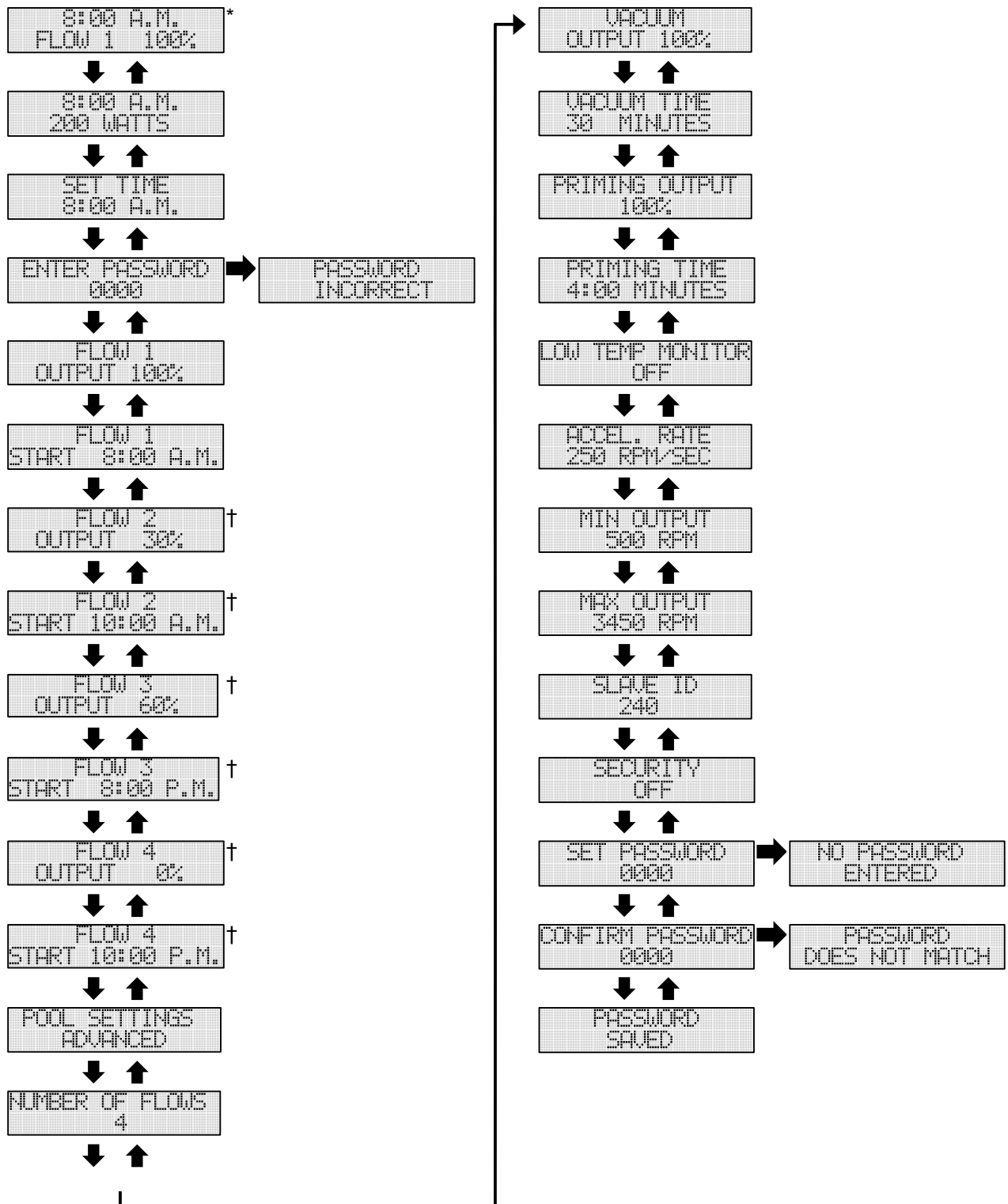


* Alternate screens are possible.

† May or may not be shown depending on the “Number of Flows” setting.

Advanced Menu

For the basics of key navigation, refer to the Motor Quick Start Guide on the inside cover of the User Interface or to **page 8** in this manual.



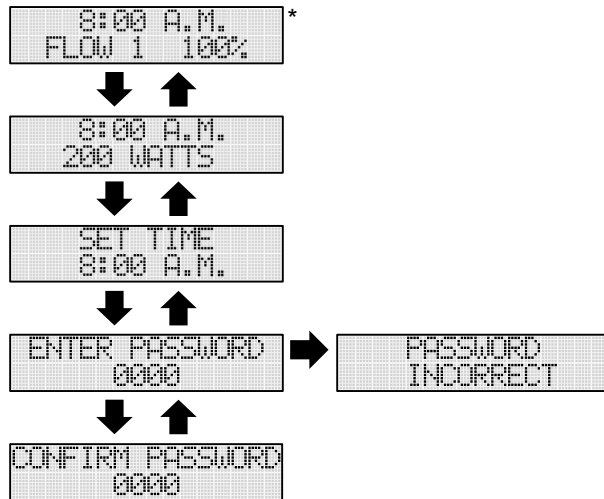
* Alternate screens are possible.

† May or may not be shown depending on the “Number of Flows” setting.

Security Locked Menu

For the basics of key navigation, refer to the Motor Quick Start Guide on the inside cover of the User Interface or to **page 8** in this manual.

You enable SECURITY LOCKED Mode by entering a PASSWORD into the control and then confirming the password. SECURITY LOCKED mode allows the user to view the current flow, watts, time setting, and enter a password to enable the other operating modes. The User Interface screen options are as follows:



* Alternate screens are possible.

Programmed Flows

One of the key advantages of the Affinity® 3 HP VSIM is the ability to set up to four (4) programmed flows. These settings control when the pump switches on and off throughout the day. The control logic begins at the flow with the earliest start time of day and continues running that flow until the next start time of day is reached. To program the number of flows, switch POOL SETTINGS to ADVANCED and scroll through the settings to NUMBER OF FLOWS and enter the number. The following procedures apply to each of the screens.

Use the ↑ / **Up** and ↓ / **Down** keys to scroll between settings. Press ENTER to edit the OUTPUT percentage. Use the ⇐ / **Left** and ⇒ / **Right** keys to navigate from one digit to the next. Press ENTER to save your changes. **Note:** Entering a FLOW value of 0% will turn the pump off for that programmed flow.

```

FLOW 1
OUTPUT 100%
  
```

Use the same procedure as above to navigate. Use the ↑ / **Up** and ↓ / **Down** keys to scroll between settings. Press ENTER to edit the START time. Use the ⇐ / **Left** and ⇒ / **Right** keys to navigate from one digit to the next. Press ENTER to save your changes.

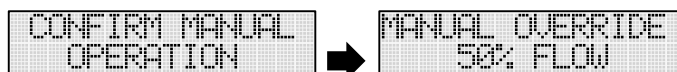
```

FLOW 1
START 8:00 A.M.
  
```

Manual Mode

MANUAL Mode gives you the ability to temporarily adjust the speed of the Affinity® 3 HP VSIM. The pump will run at the new speed until the next programmed flow time arrives, when it will switch back to normal operation. If you have only one programmed flow in your setup, the control will run in MANUAL Mode until the next day when the single programmed flow time of day is reached.

You can enable MANUAL Mode from STANDARD, ADVANCED, or SECURITY LOCKED Mode. To enter MANUAL Mode, press and hold the ⇐ / **Left** key on the User Interface for three (3) seconds. Press ENTER to confirm manual mode operation. Use the ↑ / **Up** and ↓ / **Down** keys to make adjustments. To exit MANUAL Mode, press and hold the ⇐ / **Left** key for three (3) seconds.



Pause Mode

PAUSE Mode gives you the ability to pause your Affinity® 3 HP VSIM. PAUSE Modes stops the operation of the pump.

You can enable PAUSE Mode from STANDARD, ADVANCED, or SECURITY LOCKED Mode. To PAUSE the pump operation, press and hold the ENTER key on the User Interface for three (3) seconds. To restart the pump, press and hold the ENTER key for three (3) seconds.

Watts

This screen indicates the amount of power (in Watts) the pump is consuming.



Vacuum Mode

By default, the VACUUM CYCLE runs the pump at 100% output flow for 30 minutes. To access the VACUUM CYCLE, press and hold the ⇐ / **Left** and ⇒ / **Right** keys simultaneously for three (3) seconds. Press ENTER to confirm Vacuum mode operation. To cancel the Vacuum Cycle press and hold the ⇐ / **Left** and ⇒ / **Right** keys simultaneously for three (3) seconds. You can put the pump into Vacuum Mode from STANDARD, ADVANCED, or SECURITY LOCKED Mode.



Adjust the VACUUM OUTPUT and VACUUM TIME in ADVANCED Mode.

Priming Output

Any time the Affinity® 3 HP VSIM moves from not running into running a cycle, the motor control will prime the motor by running at a set speed for a predetermined amount of time. By default, the priming cycle is 100% output for four (4) minutes. Adjust the PRIMING OUTPUT from ADVANCED Mode. You can also set the percentage value from 0% to 100%.



PRIMING OUTPUT
100%

Priming Time

Any time the Affinity® 3 HP VSIM moves from not running into running a cycle, the motor control will prime the motor by running at a set speed for a predetermined amount of time. By default, the Priming Cycle is 100% for four (4) minutes. Adjust the PRIMING TIME in ADVANCED Mode.



PRIMING TIME
4:00 MINUTES

Low Temperature Monitor

The Affinity® 3 HP VSIM monitors the ambient temperature of the pump. When the temperature falls below 4° C / 39° F temperature, the pump begins cycling on and off in an effort to keep the water from freezing in the pump. If the temperature falls below 4° C / 39° F and the pump is not currently running, the pump switches on for 30 minutes at 30% of the rated speed of the pump. The pump then idles for 30 minutes. If at the end of 30 idle minutes the temperature is still below 4° C / 39° F, the cycle repeats itself. This feature does not work when the motor is in PAUSE mode.



LOW TEMP MONITOR
OFF

Acceleration Rate

You can adjust the acceleration rate of the Affinity® 3 HP VSIM. The acceleration rate can be adjusted from 1 to 500 RPM in 1 RPM increments. ACCEL.RATE is available in ADVANCED mode. Navigate to the setting by using the flow chart on **page 11**.



ACCEL. RATE
250 RPM/SEC

Min Output

MIN OUTPUT throttles the motor so that the pump never goes lower than a certain RPM. The setting defines what 1% flow is in terms of RPM.

```

MIN OUTPUT
500 RPM
    
```

Max Output

MAX OUTPUT throttles the motor so that the pump never exceeds a certain RPM. The setting defines what 100% flow is in terms of RPM.

```

MAX OUTPUT
3450 RPM
    
```

Slave ID

Slave ID represents the MODBUS serial communications protocol address on the Affinity® 3 HP VSIM. The screen is informational. If you are hooking the pump into a larger pool control system, refer to the *Affinity® 3HP VSIM MODBUS User Manual*. Configuring MODBUS communications assumes that you are familiar with the MODBUS TCP/IP protocol.

```

SLAVE ID
240
    
```

Security Password

You activate SECURITY LOCKED mode by setting a password for the User Interface. From the SET PASSWORD setting on the ADVANCED menu, you are prompted to enter a 4-digit password. The ↑ / **Up** and ↓ / **Down** keys increase and decrease the sequence. The ⇐ / **Left** and ⇒ / **Right** keys move you to the next number. Once you set the initial password, the control prompts you to CONFIRM PASSWORD. Reenter your password. If the passwords match, the system saves the password.

Note: Write down the password and keep it in a safe location. Once the password is set, you will not be able to leave SECURITY LOCKED mode without entering the password.



Controlling the Pump

The Drive Interface board is located in the lower right-hand corner of the motor enclosure. It is powered by an isolated low voltage (+28 VDC) power supply. The interface board provides the following four interfaces for controlling the motor:

- Four Discrete Switch Inputs
- Analog 0 – 10 Volt Signal
- Analog 4 – 20mA Signal
- User Interface

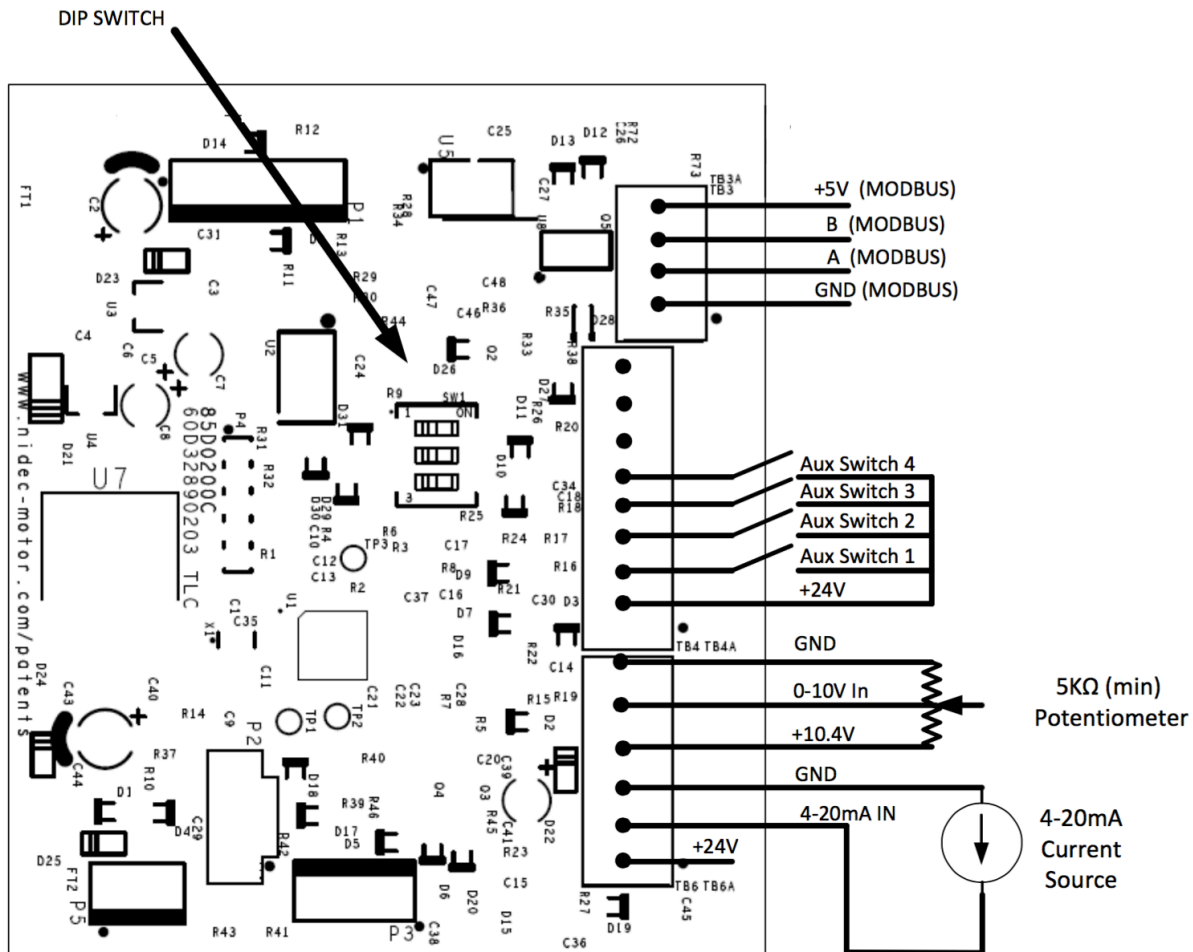


Figure 5

Terminal and Function Tables

Terminal	Function
TB3-4	+5V DC (MODBUS)
TB3-3	B (MODBUS)
TB3-2	A (MODBUS)
TB3-1	GND (MODBUS)

TB4-8	GND
TB4-7	N/A
TB4-6	NO CONNECT
TB4-5	AUX4 IN
TB4-4	AUX3 IN
TB4-3	AUX2 IN
TB4-2	AUX1 IN
TB4-1	+24V

TB6-6	GND
TB6-5	0-10V IN
TB6-4	+10.4V
TB6-3	GND
TB6-2	4-20mA IN
TB6-1	+24V

DIP Switch

All three DIP Switches on the Drive Interface board should be in the OFF position for correct operation with a User Interface. Do not adjust them in the field. The DIP Switches are read on power up only.

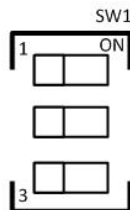


Figure 6

(Hardwire Operation)

Input Priority

The Drive Interface board uses a pre-set hierarchy for establishing which input has priority.

- Switch Inputs (with AUX4 having the highest priority)
- Analog 0 – 10 Volt
- Analog 4 – 20mA
- User Interface (lowest priority)

Discrete Switch Inputs

Switch closures on the discrete inputs operate the motor at pre-defined speeds in 25% increments of the usable speed range. Switches may be sourced from the +24V terminal, or an external DC supply may be used. When using an external supply, make sure to complete the circuit by connecting the GND terminal to the external supply's ground.

Discrete Input	RPM*
AUX1 (25%)	1215
AUX2 (50%)	1960
AUX3 (75%)	2705
AUX4 (100%)	3450

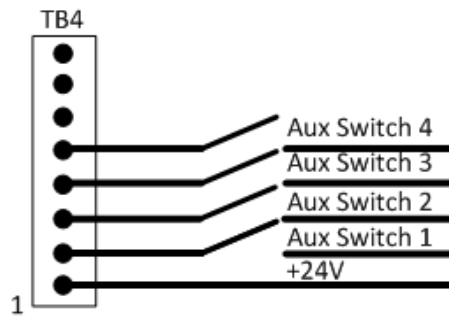


Figure 7

***Note:** The RPMs listed in the table above are based upon a minimum RPM setting of 500 and a maximum RPM setting of 3450. If you change either the minimum or the maximum RPM setting, then your values will be different. If you make a change, use the following formula to calculate your flow percentages. Using the default settings of 3450 and 500:

$$\text{AUX 1} = (((3450-500) \times (25-1))/99) + 500 = 1215 \text{ RPM.}$$

Analog 0 – 10 VDC

Motor speed can be controlled with an analog voltage signal from 0 – 10 VDC. Motor speed is proportional to the voltage level, with zero speed for zero (0) Volts and maximum speed for ten (10) Volts (the minimum operating speed is 500 RPM). The positive side of the 10 Volt variable control signal should be connected to the terminal labeled 0 – 10V IN. The ground side of the supply should be connected the GND terminal adjacent to the 0 – 10V IN terminal.

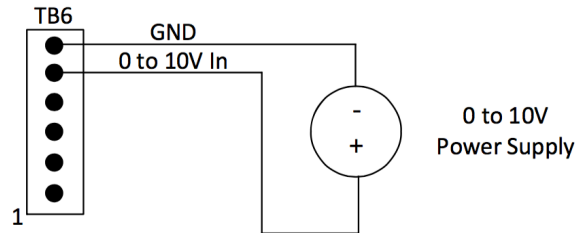


Figure 8

If an external 0 – 10V control signal is not available, the motor speed can be controlled from this input by use of a potentiometer (5K Ohms or larger). Connect the outside terminals of the potentiometer to the +10.4V and GND terminals. Connect the 'wiper' to the 0 – 10V IN terminal. Recall that this input has a lower priority than the switch inputs. Switch closures on the discrete switch inputs override the speed set by this input.

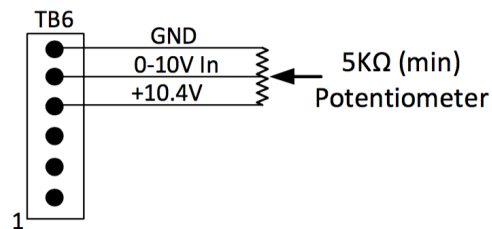


Figure 9

Analog 4 – 20mA

Motor speed can be controlled with an analog 4 – 20mA current loop. Motor speed is proportional to the current level, with zero speed for four (4) milliamps and maximum speed for twenty (20) milliamps (the minimum operating speed is 500 RPM). The positive side of the loop should be connected to the terminal labeled 4 – 20mA IN. The ground side of the loop should be connected to the GND terminal adjacent to the 4 – 20mA IN terminal. Recall that this input has the lowest input priority. Valid signals on the 0 – 10 Volts analog input or switch closures on the discrete switch inputs override the speed set by this input.

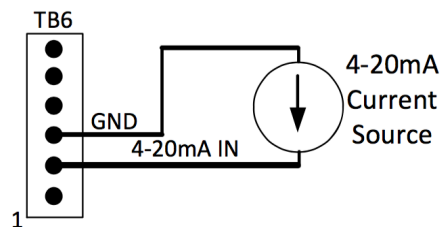


Figure 10

Section 4 –Electrical Requirements

Input

Input Line Voltage

The unit is intended to be operated from a typical 230 VAC, 50 or 60 Hz line supply. The minimum and maximum input voltage range is shown below. Full rated performance is guaranteed between the Minimum Full Performance Voltage and the Maximum Operating Voltage. The input AC supply frequency is 50 or 60 Hz nominal. The units will operate with frequency variations up to +/-5 percent of the nominal value.

Line Input 1Ø	Minimum Operating Voltage	Minimum Full Performance Voltage	Maximum Operating Voltage
230 VAC	195 VAC	210 VAC	253 VAC

DC hipot

DC hipot should be used (rather than AC). The production high pot requirement is (tests are for 1 second).

Line Voltage	Line to Case
230 VAC	2500 VDC

Input Line Current

Typical full load AC line currents are listed below. The inverter limits the inrush current to less than 20A peak surge. The duration is less than 30 milliseconds.

AC Input	Full Load Current
230 VAC	13.5 amps

Input Power Factor

The unit has power factor correction circuitry that provides improvement in power factor. The input power factor is at least 0.9 at full load.

Output

The controls are rated for the following maximum outputs:

Type	230 VAC
Max. Rated power	3.0 HP
Output Torque	4.49 lb-ft
Shaft Speed	3450 RPM

Software Protection

The unit is designed to protect itself in the event of fault situations. The fault handling is defined below:

- The drive disables power to the motor. (The motor will ramp down to a stop.)
- If the fault condition has cleared, the control attempts to automatically restart if a valid command signal is present. For example, if an over-temp fault has occurred, the motor will not attempt to restart the motor until the temperature has fallen below the fault threshold.
- The control will continue to cycle back through the sequence indefinitely as long as a valid command signal is present.

Voltage Protection

Over Voltage Protection

Exceeding +10% of the nameplate voltage will cause the motor to shut off. Excessive voltage can cause permanent damage.

Under Voltage Protection

Below minimum operating voltage, the motor will turn off.

Low Line

The unit includes input voltage sensing to allow limiting input current during low line conditions. This is accomplished by limiting output power.

Output Overpower Protection

The control monitors the output shaft power continuously using estimated speed and torque produced by the motor shaft. The control limits the torque of the motor to maintain the output shaft power below or equal to the maximum power limit. If the overload condition reduces the speed beyond the designed operating range, power limit fault will stop the motor.

Output Overcurrent Protection

The control will detect a current limit if the DC bus current envelope is above 100% of rated current. The control will reduce the output voltage in an attempt to reduce the output current level. This will normally cause a reduction in the output speed (and torque). The control will continue to run in this mode, but eventually the lower speed power limit protection takes over.

Over Temperature Protection

The unit will produce a control trip if the temperature sensed on the power device exceeds 100° C. Recovery of the temperature below 90° C will clear the over temperature trip condition. Control will reduce the torque or speed demand if the power module exceeds a temperature indicating either the motor or power module are near the specified limits.

Temperature Type	Centigrade
Fold Back Temperature	95° C
Max Temperature Limit	100° C
Recovery Time	60 seconds

Locked Rotor Protection

The control will produce a control trip when the motor fails to reach 300 RPM within 10 seconds of a start command or a lost rotor condition is detected.

Hardware Protection

Fuse Protection

The unit includes fuse protection to meet UL® component failure testing.

Any fuses are not user serviceable and are intended to last the life of the product.

Inrush Protection

See Input Line section on **page 20**.

Mechanical Requirements

Connections

Input power and control signals are via conduit connections. Two compartments are provided: one for high voltage input power and one for control inputs. The high voltage compartment has a separate cover. The high voltage compartment contains screw terminal strips appropriate for the voltage and current present and have threaded holes for 1/2-inch conduit connections for the required sealed conduit connectors. Terminal strips accommodate 14 – 6 AWG wire size for power and 24 – 16 AWG wire size for control inputs.

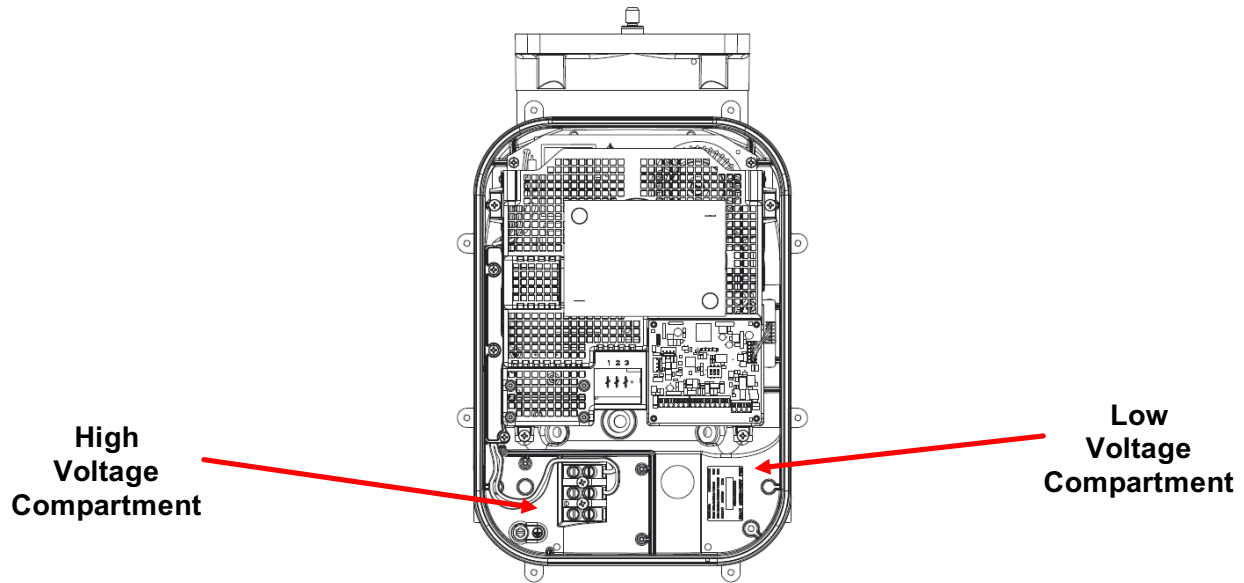


Figure 11

Environmental Requirements

Environmental Ranges

The controls are acceptable for indoor or outdoor use with temperatures ranging from -40° C to 55° C [-40° F to 131° F].

Type	Range
Full power	-10° C to 50° C
Storage temperature range	-55° C to +95° C
Humidity	0 to 99.5% RH (condensing)

Environmental Protection

IP44 rating

Section 5 –Agency

UL File Number(s):

- E255002 (motor and control assembly)
- E97751 (control)

Safety

Document	Description
ASTM D4169	Testing Shipping Containers
UL 60730-1	UL60730-1 is used as the principal standard for the design of this electronically protected motor. It requires investigation of the software, power electronics hardware, and the combined electronically protected motor.

Electromagnetic Compatibility (EMC)

Document	Description
UL 60730-1 Edition 4.0, 03-29-13 Clause H.26.11	Electrostatic Discharge Test
UL 60730-1 Edition 4.0, 03-29-13 Clause H.26.12.3	Immunity to Radiated Electromagnetic Fields
UL 60730-1 Edition 4.0, 03-29-13 Clause H.26.9	Electrical Fast Transient/Burst Immunity Test
UL 60730-1 Edition 4.0, 03-29-13 Clause H.26.8	Surge Immunity Test
UL 60730-1 Edition 4.0, 03-29-13 Clause H.26.12.2	Radio-Frequency Electromagnetic Field Immunity - Immunity to Conducted Disturbances

Section 6 – Troubleshooting

This troubleshooting guide provides field technicians a step-by-step process for accurately diagnosing and troubleshooting certain problems experienced by the Affinity® 3 HP VSIM.

It does not override or replace instructions suggested by the manufacturer of the pump system. To prevent misdiagnosis and unneeded repairs, operators should try the steps listed in the Basic Troubleshooting section first. If a problem still exists or there is an ongoing issue after following the steps in the Basic Troubleshooting section, then go to the General Troubleshooting section for further guidance.

Basic Troubleshooting

Motor shaft is not spinning or runs abnormally

- Verify the pump should be running based upon the time of day and how you have the pump programmed.
- Check the circuit breaker for trips or accidental shutoff.
- Verify the signal cable and power leads are securely connected to control unit connectors; inspect for shorts, detached wiring, or loose connections.

Motor rattles or makes excessive noise

- Inspect the motor for accumulated dirt, debris or other signs of damage.
- Inspect the motor for secure mounting to system chassis.
- Inspect the shaft; verify that the shaft is not bent and that the motor shaft spins freely in both directions.

General Troubleshooting

Symptom	Possible Cause	Corrective Action
Motor fails to start.	Blown fuse or tripped circuit breaker	Turn OFF motor. Replace the fuses with a time delay type or reset the breaker.
	Incorrect voltage to motor	Verify motor voltage to the terminals match the nameplate voltage requirements. For the 230 Volt model: 195-253 Volts is the allowable voltage range. If there is a timer, counter or line switch, verify they are in the ON position.
	Improper terminal connections	Turn OFF power. Verify connections are per the terminal connection section of this manual.

Symptoms	Possible Cause	Corrective Action
Motor does not come up to full speed.	Low voltage	Verify the motor voltage to the terminals matches the nameplate voltage requirements +/- 10%
	Low temp	A control temperature of -10° C or below will limit output power by 50% until control temperature goes above -10° C.
Motor stalls during operation.	Overloaded Motor	With power disconnected, verify the pump rotates freely.
	Low voltage	Verify that the motor voltage to the conduit box connection terminals matches the nameplate voltage requirements.
Motor vibrates or is excessively noisy.	Pump	Check the pump to ensure it is properly connected to the motor shaft. Check pump impeller for damage. Make sure there are no foreign objects inside pump. Before taking any corrective actions, ensure that the power is OFF.
	Motor Base (if applicable)	Verify the motor base (if applicable) is not cracked and that the four mounting bolts have been tightened.
Motor is not operating properly.	Command Signal	Check the command signal to ensure that it is above the Start Threshold. Check line voltage.

Section 7 – Default Settings

Setting	Value	Units
Flow 1 Output	100	%
Flow 1 Start Time	8:00 A.M.	
Flow 2 Output	30	%
Flow 2 Start Time	10:00 A.M.	
Flow 3 Output	60	%
Flow 3 Start Time	8:00 P.M.	
Flow 4 Output	0% (Off)	%
Flow 4 Start Time	10:00 P.M.	
Pool Settings	Standard	
Number of Flows	4	
Vacuum Output	100	%
Vacuum Time	30	Minutes
Priming Output	100	%
Priming Time	240	Seconds
Low Temperature Monitor	Off	
Acceleration Rate	250	RPM/sec
Minimum Output	500	RPM
Maximum Output	3450	RPM
Slave ID	240	
Security	Off	
Password	None	

Section 8 –RPM vs Percentage Flow

This table is only applicable with the default maximum and minimum RPM tables. **Note:** The RPMs listed in this table are based upon a minimum RPM setting of 500 and a maximum RPM setting of 3450. If you change either the minimum or the maximum RPM setting, then your values will be different. If you make a change, use the formula below to calculate your flow percentages. Using the default settings of 3450 and 500, the formula is as follows:

$$\text{AUX 1} = (((3450-500) \times (25-1))/99) + 500 = 1215 \text{ RPM.}$$

RPM	Percentage
0	0*
500	1
619	5
768	10
917	15
1066	20
1215	25
1364	30
1513	35
1662	40
1811	45
1960	50
2109	55
2258	60
2407	65
2556	70
2705	75
2854	80
3003	85
3152	90
3301	95
3450	100

* Entering a FLOW value of 0% will turn the pump off for that programmed flow.

†All marks shown in this document are properties of their respective owners.

© 2017 Nidec Motor Corporation. All rights reserved. U.S. Motors®, SR Drives®, Hurst®, Rescue®, ECOTECH-EZ®, and EcoApex® are registered trademarks of Nidec Motor Corporation.

Nidec Motor Corporation trademarks followed by the ® symbol are registered with the U.S. Patent and Trademark Office.

For more information

8050 W. Florissant Avenue | St. Louis, MO 63136

Phone: 800-566-1418

FAX: 314-595-8922

www.usmotors.com

