PerfectSpeed® NEMA 48 Pump Motor

With User Interface

Operation, Configuration, and Troubleshooting Manual

Nidec

All for dreams

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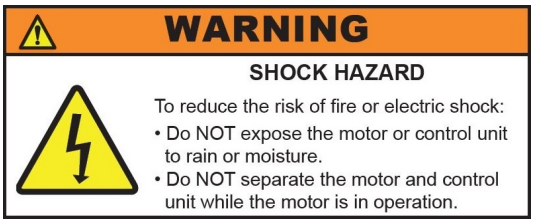
Section 1 - PerfectSpeed® Motor

The PerfectSpeed® ECM User Interface developed by Nidec Motor Corporation easily integrates into non-communicating systems using state-of-the-art technology. The motor is a high-efficient Brushless DC (BLDC) permanent magnet motor that offers variable speed. Sensorless sine wave control assures quiet and ultra-smooth performance.

Important Safety Information



⚠ WARNING

- Only trained and qualified professionals familiar with PerfectSpeed® motors should service the motor and control unit.
- 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.

⚠ WARNING

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:

- Insulate all connections carefully to prevent grounding or short circuits. Reinstall all conduit and terminal box covers. To avoid overheating and 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 *National Electrical Code Handbook* and *NFPA No. 70.* Employ qualified electricians.
- Code requirements differ from state to state. Install equipment 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.
- Make sure there are no unusual noises or vibrations when the motor is running.
- If noise and vibration are observed, refer to the appropriate Troubleshooting section.
- Avoid contact with energized circuits or 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.

⚠ WARNING

Always disconnect electrical power at the fuse box or circuit breaker 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 the power is removed, and that it is locked out while you are working on the equipment.

⚠ WARNING

A poor electrical connection can overheat and cause terminal and/or terminal board failures. Examine the wiring harness quick-connect terminals carefully for any signs of physical deterioration or loose fit to the terminals on the motor terminal board.

Care must be taken to assure connections are made to the proper terminals and adequate electrical clearances are maintained.

⚠ WARNING

The control unit on the motor contains potentially hazardous voltage.

⚠ CAUTION

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

NOTICE

- Voltage symbols vary among different multimeters and may be displayed as V ac, AC, V, or a V beneath a wavy line. Select the correct symbol and set the multimeter to the voltage closest to the voltage you are measuring.
- Read all instructions thoroughly and be familiar with the equipment before installing or working on it.
- The PerfectSpeed® motor is properly packaged for shipment and storage and should be kept in a clean and dry indoor area.

Overview

The interface board communicates with the motor control to operate the motor in speed mode. The operating parameters are programmed in the EEPROM of the motor control, not the PerfectSpeed® User Interface. On power up the interface board extracts the operating parameters from the motor control. Parameter categories include:

- Motor Direction
- Motor Mode of Operation
- Motor Output Display
- Motor Profile

PerfectSpeed® User Interface Box

The PerfectSpeed® operates in speed mode when connected to the pump. You can adjust the demand of the motor manually using the PerfectSpeed® User Interface. The motor information displayed in the User Interface is outlined in Table 1. If the motor encounters a problem, the User Interface displays a corresponding error code. These are outlined in **Table 1** as well.

Table 1 – User Interface Display Information

Control Mode	Data Displayed
Speed (speed feedback)	**Spd** – followed by the instantaneous speed in RPM **dE** – followed by S + demand in %
Error Codes	**E1** – No communications **E2** – Under Voltage **E4** – Non-NMC Motor

Minimum and Maximum Operating Parameters

The PerfectSpeed® motor operates properly within minimum and maximum parameters. Your settings must be within these ranges.

Table 2 – B&G Centrifugal Pump & Motor Operating Parameters

Control Mode	Minimum	Maximum
Speed	300 RPM	Series 60: 1725 RPM Series e-90: 1765 RPM

Input Demand

There are two methods of setting the input demand using the PerfectSpeed® User Interface box.

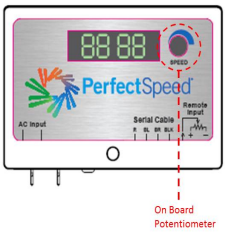
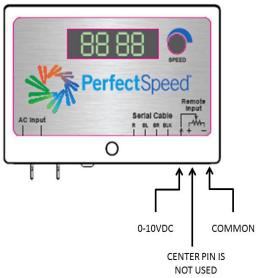
Table 3 – Input Demand Options

Input Demand Setting Method	Definition
Set with On-Board Potentiometer	The input demand can be set via the On-Board Potentiometer. An external input is not necessary.
Set with 0 - 10 VDC control signal	When an external controller is connected, the On-Board Potentiometer should be set fully CCW (0%). Otherwise, the actual demand seen by the pump is offset by the setting of the On-Board Potentiometer.

Connection Diagrams

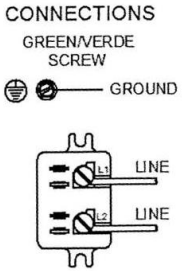
There are two methods of setting the Input Demand. See **Table 3** for definitions of the two options.

Table 4 – Setting Input Demands Options

Set with On-Board Potentiometer	Set with 0-10VDC Control Signal
	

AC Line Connections

Check **to see if the line voltage matches the nameplate voltage**.

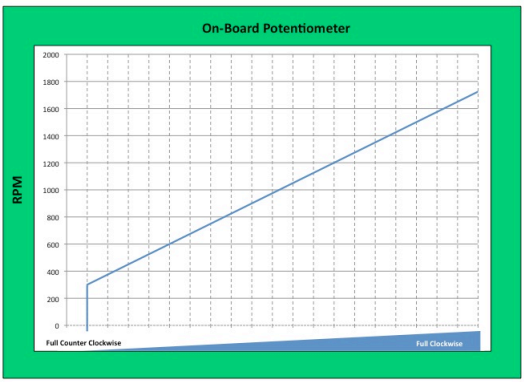


Configuration Scenarios

This section provides examples of different configurations and briefly describes how the motor operates under those conditions.

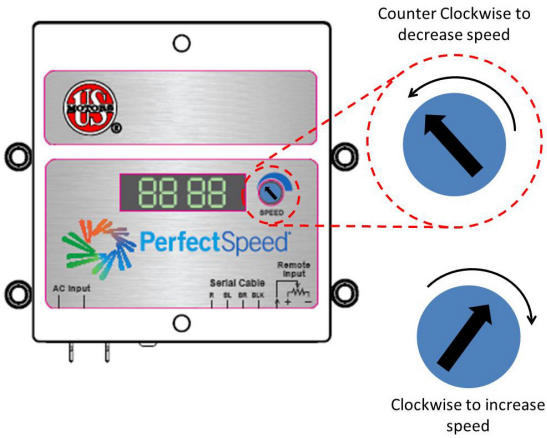
Operating Parameters

Speed will change linearly based on the On-Board Potentiometer or remote 0-10 VDC signal. The graph below illustrates the operation of a motor adjusted with the On-Board Potentiometer.

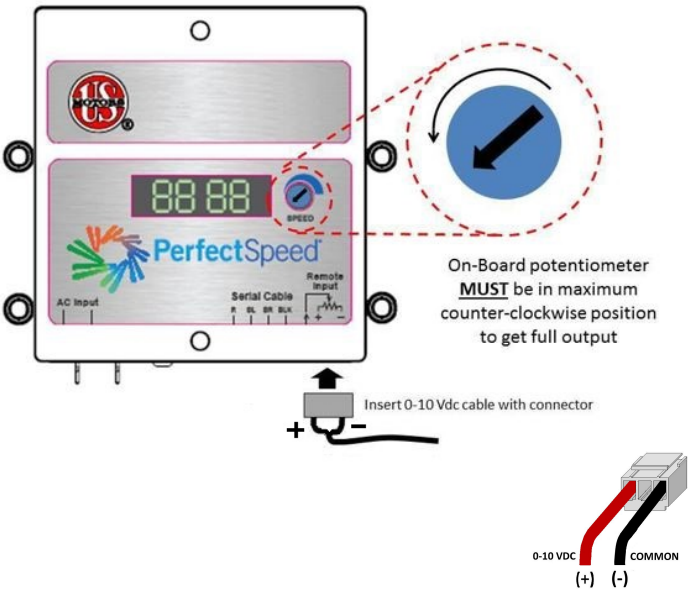


At 0.5 VDC signal, the motor will come on at 300 RPM and ramp linearly to 1725 for Series 60 pumps and 1765 RPM for Series e-90 pumps.

Adjusting Pump Speed (RPM) With On-Board Potentiometer



Using 0-10 VDC signal



Section 2 - Troubleshooting

This section provides field technicians with a step-by-step process for accurately diagnosing and troubleshooting difficulties that may be experienced by NMC PerfectSpeed® motors and the PerfectSpeed User Interface box. It does not override or replace instructions suggested by the manufacturer of the fluid circulating system.

To prevent misdiagnosis and unneeded repairs of the motor, operators should try the steps listed in the **Basic Troubleshooting of the Motor** section first. If a problem still exists or there is an ongoing issue after following the outline in that section, then proceed to the Motor and Control Unit Diagnostics section for additional testing instructions.

Basic Troubleshooting of the Motor

NOTICE

Always begin your inspection of the motor by stepping through this section.

Motor Is Not Spinning or Runs Abnormally

- Check the circuit breaker for trips or accidental shutoff.
- Verify that the cables and power cord are securely connected to the control unit connectors.
- Inspect for shorts, detached wiring, or loose connections.
- Inspect the control unit for broken or loose connectors, moisture, excessive dirt, or other damage.

Motor Rattles or Makes Excessive Noise

- Inspect the motor and pump for accumulated dirt, internal debris, or other signs of damage.
- Inspect the shaft and verify that the motor shaft spins freely by hand in both directions without effort.

PerfectSpeed® Motor and User Interface

Motor Is Not Running

If the PerfectSpeed® motor with User Interface isn't running, perform the following checks:

1. Ensure that both the PerfectSpeed® motor and User Interface have proper line voltage for intended application.
2. Turn the User Interface on-board potentiometer fully clockwise (100% demand) and check to see if the motor runs.
3. If 0-10 VDC input is in use, disconnect the external input from the User Interface and perform **Check 2**.
4. Check the digital read-out of User Interface for an error code:

Table 5– User Interface Error Codes

Error Code	Reason	Action
E1	No Communication	Remove power from both the PerfectSpeed® motor and User Interface for four (4) minutes, then reconnect power and test again. Check the communication cable connection between the PerfectSpeed® motor and User Interface. Check the continuity of the communication cable (pin 1-1, pin 2-2 pin 3-4, and pin 4-3).
E2	Low Voltage	This is a reading from the PerfectSpeed® motor itself. Ensure that there is at least 71 VAC (for 115 VAC applications) or 142 VAC (for 230 VAC applications).
E4	Not a NMC Motor	Connect to a NMC motor.

Check 2: Electrical Troubleshooting

1. Disconnect or remove power to the equipment being serviced and allow four (4) minutes for the capacitors to discharge any residual voltage.
2. Check the rotation and speed of the motor. Determine if the motor can spin freely by hand without effort or assisted means. If any binding occurs, replace the motor and control unit.
3. Determine whether the system is wired for 120 VAC power or 240 VAC power.
4. Disconnect the power cord from the connector on the control unit. Inspect the power cord for bent, damaged, or recessed wires and terminals [Figure 1].

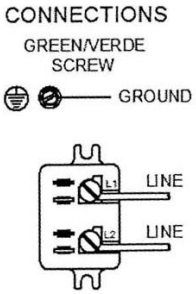


Figure 1

5. Disconnect or remove AC power to the equipment being serviced and allow four (4) minutes for the capacitors to discharge any residual voltage.
6. Proceed to Check 3.

Check 3: Motor Verification

1. Disconnect or remove AC power to the equipment serviced and allow four (4) minutes for the capacitors to discharge any residual voltage.

2. Make sure that the motor shaft spins freely by hand without effort in both directions [Figure 2].

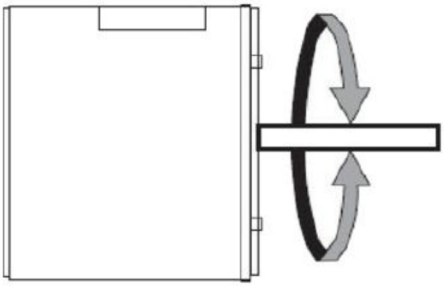


Figure 2

- Replace the motor and control unit if the shaft does not spin freely by hand without effort.

Final Checks of the Motor

- Check the mounting and fastening of the motor and control unit. Make sure the motor and the control unit are securely attached together and mounted tightly in the system.
- Check the control unit connectors. Inspect for shorts, detached wiring, or loose connections
- Check the motor and verify the rotation of the driven load. Make sure it spins freely by hand in both directions without effort or assisted means.
- Check all circuit breakers.

Section 2 - Glossary

The glossary contains definitions for acronyms and terms occurring in the Operation, Configuration, and Troubleshooting Manual or in the PerfectSpeed® User Interface.

CCW
Counter-clockwise direction. Motor rotation is viewed from the lead end of the motor, not the shaft.

CW
Clockwise direction. Motor rotation is viewed from the lead end of the motor, not the shaft.

dE
Demand. The set point of the motor.

ECM
Electronically Commutated Motor.

EEPROM
Electronically Erasable Programmable Read Only Memory. A memory chip in the control capable of retaining data when the power supply is removed.

Inch Pounds (lb-in)
A unit of pressure resulting from a force of one pound-force applied to an area.

init
Appears in the digital display on the PerfectSpeed® User Interface when the motor is in the process of initializing.

Input
The controlling device, 0 to 10 volts (DC).

LE
The end of the motor opposite the shaft extension from which the rotation of the shaft and driven load are determined.

Max Power
The horsepower rating in watts delivered by the motor.

Max Speed
Maximum functioning speed of motor in Speed Mode.

Min Speed
Minimum functioning speed of motor in Speed Mode.

Max Torque
The torque point at the highest speed just below power limiting of the motor.

Maximum Demand (%)
The highest value of operation relating to motor limits as defined in the Motor Mode of Operation. It is represented as the upper limit of the Y-axis in the Motor Profile graph.

Maximum Input (%)
The highest value of control method (on-board potentiometer, or 0 – 10 VDC). It is represented as the upper limit of the X-axis in the Motor Profile graph.

Minimum Demand (%)
The lowest value of operation relating to motor limits as defined in the Motor Mode of Operation. It is represented as the lower limit of the Y-axis in the Motor Profile graph.

Minimum Input (%)
The lowest value of control method (on-board potentiometer, or 0 – 10 VDC). It is represented as the lower limit of the X-axis in the Motor Profile graph.

Message Timeout
A message referring to a communication failure between the computer and motor.

Motor HP
The horsepower rating of the motor.

Motor flow Limit
A user-defined limit (in GPM) equating to 100% demand in **flow** Mode of Operation.

Motor Ramp Rate
The time (in seconds) it takes the motor to go from 0 to maximum RPM as defined by the maximum operating parameters. Also called motor slew rate.

Motor Speed Limit
A user-defined limit (in RPM) equating to 100% demand in **Speed** Mode of Operation.

Motor Power Limit
A user-defined limit (in Watts) of output power. The parameter cannot be less than 25% of the value in the Motor Table. Refer to **Appendix A: Motor Charts**.

Motor Torque Limit
A user-defined limit (in lb – in) equating to 100% demand in Torque Mode of Operation. The parameter cannot be less than 25% of the value in the Motor Table. Refer to **Appendix A: Motor Charts**.

NEC
National Electric Code

NFPA
National Fire Protection Association

NTC
Negative temperature coefficient

OEM
Original Equipment Manufacturer

On-Board Potentiometer
The adjustment feature on the PerfectSpeed® User Interface.

PWM
Pulse Width Modulation.

Software Version
The version of the software in the motor.

Speed
The speed level measured in RPM.

Torque
The measure of how much a force acting on an object causes that object to rotate.

VAC
Voltage in Alternating Current

VDC
Voltage in Direct Current

Section 4 - Appendix A: Motor Charts

Maximum Torque and Speed varies depending on the model of the motor and the horsepower rating.

Table 6 – Maximum Speed and Torque

Horsepower	Torque (lb-in)	Speed
1 Series 60	45	1725
½ Series 60	22.5	1725
1 Series e-90	45	1765
½ Series e-90	22.5	1765

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