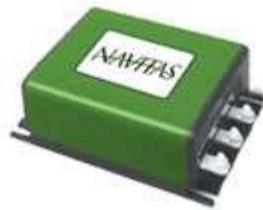![Navitas logo]

PSE1000/PSE550

PUMP MOTOR CONTROLLER
PRODUCT MANUAL

VERSION 2.1

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TABLE OF CONTENTS

I. INTRODUCTION

This manual outlines the installation and set-up of the PSE1000 and PSE550 pump motor controllers. These controllers eliminate the need for a pump contactor and control the pump motor more efficiently and accurately than conventional systems.

The PSE1000/PSE550 can be installed on their own, but more features are available when they are used with an TSE1000 or TSE550 drive motor controller.

IF YOU ARE INSTALLING THE PSE1000 OR PSE550 WITH AN TSE1000/TSE550 refer to the installation directions in section I B on page **Error! Bookmark not defined.** and the programming directions in section II B on page 13.

IF YOU ARE INSTALLING THE PSE1000 OR PSE550 ON ITS OWN refer to the installation directions in section I C on page 6 and the manual programming instructions in section II C on page 16.

The table below outlines the power capacities of the PSE1000 and PSE550.

FEATURE	**PSE1000**	**PSE550**
Battery Voltage	24 - 48 volts	24 - 48 volts
Peak Current Limit	1000 Amps	550 Amps
Continuous Current	325 Amps	175 Amps
Switch Inputs	4 separate inputs	4 separate inputs
Motor Size	up to 15 HP	up to 5 HP

II. INSTALLATION

A. MOUNTING THE PSE1000/PSE550

NOTE: Before beginning the installation unplug the battery and make sure the key switch is turned off.

- Remove the pump contactor and its wiring .

- Find a suitable mounting location for the PSE1000/PSE550. The mounting surface must be flat and large enough to ensure good heat dissipation. Remove the paint from the surface of the truck and apply a light coat of thermal transfer compound.

- Drill 4 holes using the mounting template (included in the package with your PSE1000/PSE550). Use the slots located in the four corners of the controller base to bolt it in place. **You must use four bolts equally torqued** to secure the controller.

B. INSTALLING A PSE1000 OR PSE550 WITH AN TSE1000/TSE550

1. Wiring Instructions

- Plug the 9-wire harness onto the upper right-hand set of pins. Make sure that the white/black wire is connected to the last pin on the right. See the *PSE1000/PSE550 Connector Pins* diagram on p. 11 for reference.

- Refer to the wiring diagram on page 5 for more assistance with the directions given below.

a) Accelerator/Potentiometer

The PSE1000/PSE550 can be used with or without an accelerator on the lift lever. If you use an accelerator it must have a 5,000 Ohm potentiometer (5,000 Ohms at rest and 0 Ohms at full speed)[1]. The *white/blue* and *white/green* wires are used to connect the accelerator to the PSE1000/PSE550.

WITH AN ACCELERATOR:

- Connect the *white/green* wire to one side of the accelerator/potentiometer.

- Connect the *white/blue* wire to the other side of the accelerator/potentiometer.

WITHOUT AN ACCELERATOR:

- Clip and insulate the ends of the *white/green* and *white/blue* wires.

NOTE: You must use either an accelerator or at least one motor level switch.

b) Battery-Lift Interlock

You can use the PSE1000/PSE550 with the battery-lift interlock built into the TSE1000/TSE550, or you can use an external battery-lift interlock if you prefer. The *white/gray* wire is used to connect the PSE1000/PSE550 to external battery monitoring equipment. If you are not using an external device you must still connect this wire (see the directions below).

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[1]The wiring for the PSE1000/PSE550 can be adapted to work with other types of accelerators as well. Please see the Product Manual for more information.

WHEN USING THE BUILT-IN LIFT INTERLOCK:

- If you are planning to use the battery monitoring built-in to the TSE1000/TSE550 you must connect the *white/gray* wire to B- (battery negative).

CONNECTING AN EXTERNAL INTERLOCK:

- Connect the *white/gray* wire to the output of the battery-lift interlock device.
- Use the ProBit to turn off the built-in low battery lift lock. See the ProBit manual for more information.

As the controller is shipped, the battery-lift interlock device must supply B- (not B+) to the controller. Most battery interlocks work this way. However, if you are using a device that supplies B+ you can program the PSE1000/PSE550 to work with it.

- Using the ProBit check in the options for programming the PSE1000/PSE550 and *change the polarity of the external gauge*.

NOTE: The *white/gray* wire cannot be left unconnected.

c) Motor Level Inputs

The PSE1000/PSE550 gives you the option of setting up to four different motor levels using the truck's lift, tilt, side-shift and other switches. You can connect more than one switch to the same level input.

When choosing which switch to use with which input you should remember that the motor voltage for **level 1** (100%) will always override the others; **level 2** (80%) will override levels 3 and 4, and **level 3** (60%) will always override **level 4** (40%). For example, if switches one and two are on at the same time, the controller will operate with the setting for level 1.

Before connecting these switches **PLEASE READ** *Programming with a ProBit* on p. 13, for more information. You can change the setting (percentage of full motor voltage) for each level.

IF YOU ARE NOT USING THE MOTOR LEVEL INPUTS:

- Clip and insulate the ends of the *white/red, white/brown, white/orange, and white/purple* wires.

IF YOU ARE USING SOME OR ALL OF THESE INPUTS:

- Clip and insulate the ends of any inputs you are not using.
- Run the *white/red* wire through the switch for **level 1** and connect it to the switched side of the key switch.
- Run the *white/brown* wire through the switch for **level 2** and connect it to the switched side of the key switch.
- Run the *white/orange* wire through the switch for **level 3** and the *white/purple* wire through the switch for **level 4** and then connect each one to the switched side of the key switch.

NOTE: You must use either an accelerator or at least one motor level switch.

d) SRO

You can connect the SRO input so that the pump will only operate when the driver is on the truck, or you can connect it so that the pump can be operated even when the driver is not in driving position.

IF YOU WANT THE PUMP TO OPERATE ALL THE TIME:

- Connect the *white/yellow* wire to the switched side of the key switch.

IF YOU WANT THE PUMP TO OPERATE ONLY WHEN THE DRIVER IS IN PROPER DRIVING POSITION:

- Connect the *white/yellow* wire to the switched side of the seat switch (or floor switch in a stand-up truck).

NOTE: The SRO input must be connected to some B+ source in order for the PSE1000/PSE550 to operate.

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e) The Bus

Plug the bus harness (the branched harness) onto the upper left-hand set of pins (see the *PSE1000/PSE550 Connector Pins* diagram p. 11) on both the pump controller and the TSE1000/TSE550. Connect one branch of the PSE1000/PSE550 harness to one branch of the TSE1000/TSE550 harness (see figure below).

Be sure to protect the unconnected ends of the two harnesses since they are live. One of these ends will be used to plug in the ProBit.
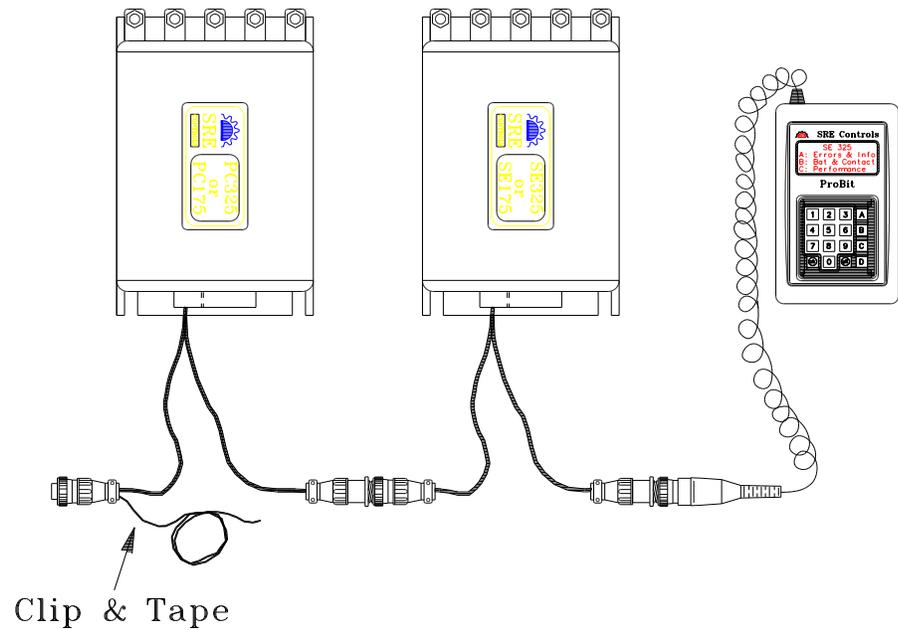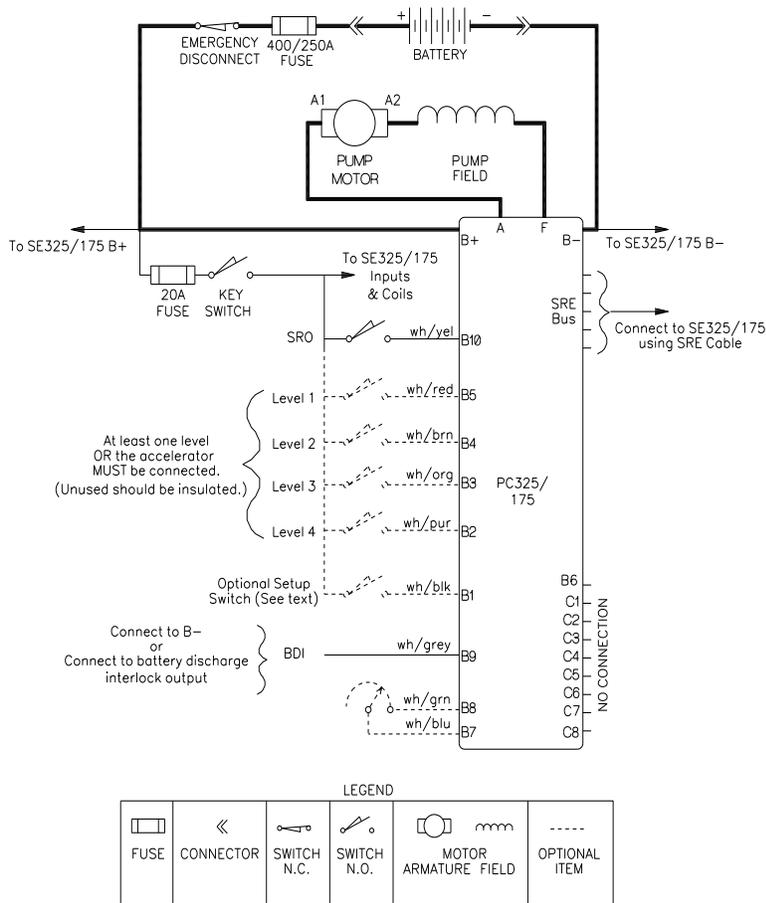
2.Wiring Diagram (PSE1000/175 with TSE1000/175)

Figure 1: Wiring for Pump Controller with a Drive Motor Controller

C. INSTALLING A PSE1000/550 ON ITS OWN

1. Wiring Instructions

- Plug the bus harness (the branched harness) onto the upper left-hand set of pins (see the *PSE1000/PSE550 Connector Pins* diagram on page 11).

- Plug the 9-wire harness onto the upper right-hand set of pins. Make sure that the white/black wire is connected to the last pin on the right. See the *PSE1000/PSE550 Connector Pins* diagram on p. 17 for reference.

- Refer to the wiring diagram on p. 9 for more assistance with the instructions below.

a) Key Switch

- Connect the two ends of the branched harness as shown in the diagram below.

- Connect the loose red wire (attached to the female plug) to the switched side of the key switch.
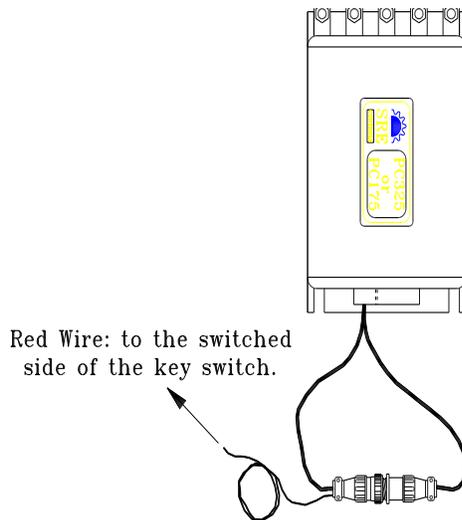

Red Wire: to the switched side of the key switch.

Figure 2: Connecting the Bus Harness to the PSE1000/PSE550 on Its Own

b) Battery-Lift Interlock

The *white/gray* wire is used to connect the PSE1000/PSE550 to external battery monitoring equipment.

IF YOU ARE NOT USING A BATTERY-LIFT INTERLOCK

- Connect the *white/gray* wire to B-.

IF YOU ARE USING A BATTERY-LIFT INTERLOCK

- Connect the *white/gray* wire to the output of the battery-lift interlock device.
  NOTE: If your battery-lift interlock device supplies B+ you can connect it to the SRO.

c) Accelerator/Potentiometer

The PSE1000/PSE550 can be used with or without an accelerator on the lift lever. If you use an accelerator it must have a 5,000 Ohm potentiometer (5,000 Ohms at rest and 0 Ohms at full speed). Other configurations can also be wired in (see Product Manual for more information). The *white/blue* and *white/green* wires are used to connect the accelerator to the PSE1000/PSE550.

WITH AN ACCELERATOR:

- Connect the *white/green* wire to one side of the accelerator/potentiometer.

- Connect the *white/blue* wire to the other side of the accelerator/potentiometer.

WITHOUT AN ACCELERATOR:

- Clip and insulate the ends of the *white/green* and *white/blue* wires.

NOTE: You must use either an accelerator or at least one motor level switch.

d) Motor Level Inputs

The PSE1000/PSE550 gives you the option of setting up to four different motor levels using the truck's lift, tilt, side-shift and other switches. You can also connect two or more switches to the same motor level input.

When choosing which switch to use with which input you should remember that the motor voltage for **level 1** (100%) will always override the others; **level 2** (80%) will override levels 3 and 4, and **level 3** (60%) will always override **level 4** (40%). For example, if switches one and two are on at the same time, both of them will operate with the setting for level 1.

You can change the percentages for each level. See p. 16, *Manual Programming* for more information.

IF YOU ARE NOT USING THE MOTOR LEVEL INPUTS:

- Clip and insulate the ends of the *white/red, white/brown, white/orange, and white/purple* wires.

IF YOU ARE USING SOME OR ALL OF THESE INPUTS:

- Clip and insulate the ends of any inputs you are not using.
- Run the *white/red* wire through the switch for **level 1** and connect it to the switched side of the key switch.
- Run the *white/brown* wire through the switch for **level 2** and connect it to the switched side of the key switch.
- Run the *white/orange* wire through the switch for **level 3** and the *white/purple* wire through the switch for **level 4** and then connect each one to the switched side of the key switch.

NOTE: You must use either an accelerator or at least one motor level switch.

e) SRO

You can connect the SRO input so that the pump will only operate when the driver is on the truck, or you can connect it so that the pump can be operated even when the driver is not in driving position.

IF YOU WANT THE PUMP TO OPERATE ALL THE TIME:

- Connect the *white/yellow* wire to the switched side of the key switch.

IF YOU WANT THE PUMP TO OPERATE ONLY WHEN THE DRIVER IS IN PROPER DRIVING POSITION:

- Connect the *white/yellow* wire to the switched side of the seat switch (or floor switch in a stand-up truck).

NOTE: The SRO input must be connected to some B+ source in order for the PSE1000/PSE550 to operate.
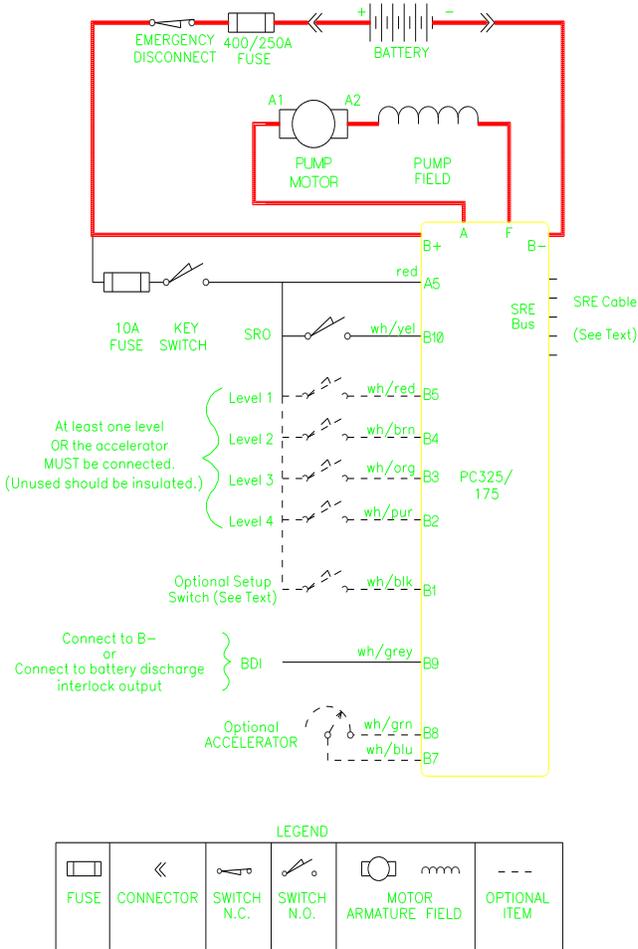
2. Wiring Diagram (for the PSE1000/PSE550 Alone)

Figure 3: Wiring for Pump Controller without a Drive Motor Controller

D. WIRING HARNESS IDENTIFICATION

The PSE1000/PSE550 needs two harnesses for proper installation. The 10-pin harness is used to connect all the truck's inputs. The bus harness (which has two branches) is used to connect the PSE1000/PSE550 to a drive motor controller or, if you are using the PSE1000/PSE550 alone, to the key switch. The figure and table below identify the harness wires in more detail.

Pin #	Connection	Wire Colour
A1 - A5	Navitas bus pins for connection to an TSE1000/TSE550 or to a ProBit	
B10	SRO input	white/yellow
B9	connection for external battery-lift interlock	white/gray
B8	Throttle 1 input	white/green
B7	Throttle 2 input	white/blue
B6	not used	
B5	level 1 motor voltage	white/red
B4	level 2 motor voltage	white/brown
B3	level 3 motor voltage	white/orange
B2	level 4 motor voltage	white/purple
B1	used for manual setup	white/black

Table 1: Wiring Harness Identification
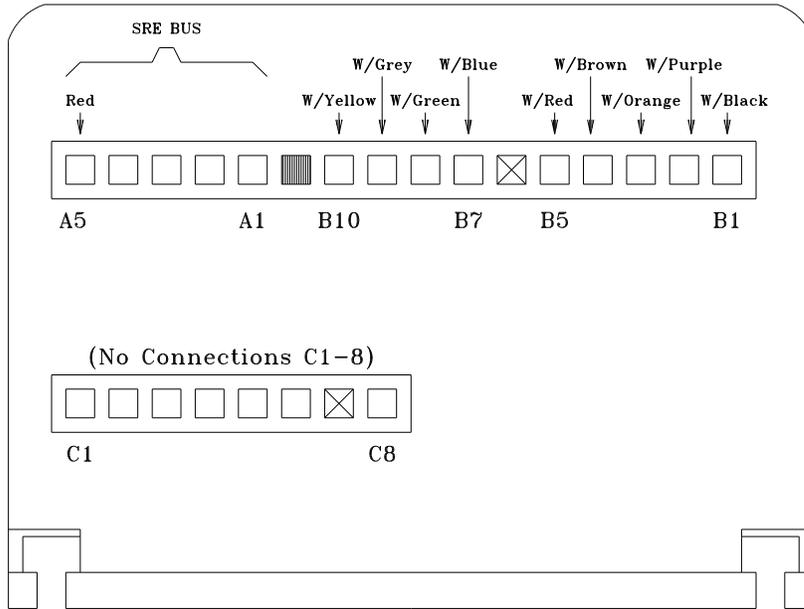
E. CONNECTOR PIN IDENTIFICATION

Figure 4: PSE1000/PSE550 Connector Pins

F. MOTOR CABLE CONNECTIONS

Instructions and Diagram

CAUTION: Do not connect power to the controller until the installation is complete.

- Connect *battery positive* (B+) to the power bar labeled **B+** on the controller (through the appropriate fuse and emergency disconnect device).
- Connect one of the pump motor terminals to the power bar labeled **A** on the controller.
- Connect the other pump motor terminal to the power bar labeled **F** on the controller.
- Connect *battery negative* (B-) to the power bar labeled **B-** on the controller.

WARNING: Improper wiring of the B+ and B- connections can cause permanent damage to the controller! The warranty does not cover reversed battery connections.
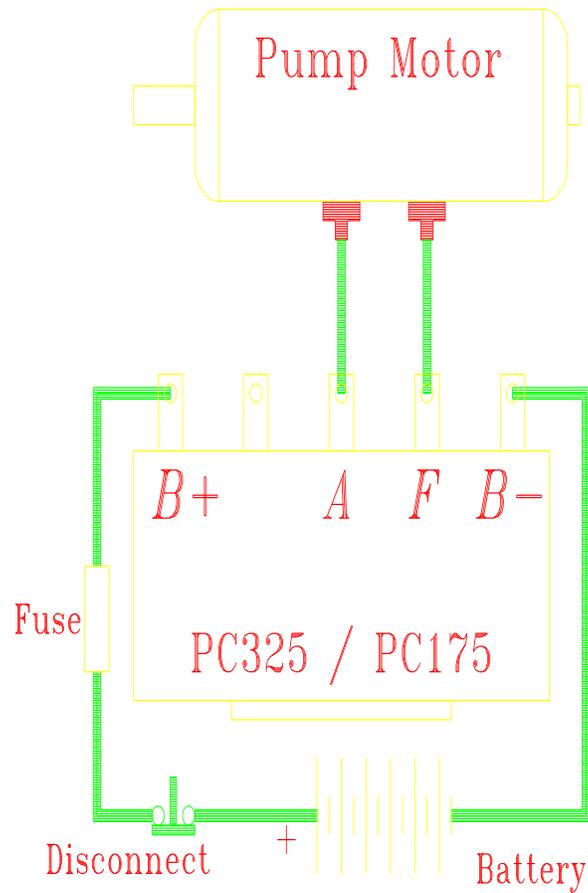
III.   PROGRAMMING

A. PROGRAMMABLE SETTINGS

The four motor levels can be used as they come from the factory or they can be reset to suit your needs. Programming is easiest with the ProBit (see the section on *Programming with a ProBit* below), but you can also set levels manually with a simple switch (see the section on *Manual Programming*, p. 16 below).

NOTE: If you are using a PSE1000/PSE550 by itself (i.e. if you do not have an TSE1000/TSE550) you cannot use the ProBit for programming.

PARAMETER	MEASURED BY	RANGE	PRESET LEVEL
motor level 1	percentage of full motor voltage	0 - 100%	100%
motor level 2	percentage of full motor voltage	0 - 100%	80%
motor level 3	percentage of full motor voltage	0 - 100%	60%
motor level 4	percentage of full motor voltage	0 - 100%	40%
acceleration	time to full motor output	0.25 - 32 sec.	0.5 sec.
throttle minimum	Percentage offset for throttle rest	0 - 100%	20%
throttle maximum	percentage of full accelerator travel	0 - 100%	80%
throttle polarity	whether the throttle reads 0 ohms at rest (min.) or at full (max.)	min. or max.	max.

Table 2: Programmable Parameters

B. PROGRAMMING WITH A PROBIT

All of the features listed in table 2 above are programmable with the ProBit. In most cases the truck should work with the default (or preset) settings, but you can also use the ProBit to change these to fit the truck more exactly. Below is an explanation of each programmable feature.

1. Throttle Minimum and Throttle Maximum

Throttles/potentiometers hardly ever work to their full mechanical and electrical potential. Most throttles do not move all the way back to the point where the potentiometer reads 5000 Ohms. In the same way, they cannot be pushed all the way to where the potentiometer reads 0 Ohms. Often 25% or more of the total travel is lost. A motor only reaches full output when the potentiometer reads 0 ohms. So, this loss means the motor will never get all the way to 0 Ohms, and therefore will never reach its full possible speed/voltage.

By programming the PSE1000/PSE550 you can make up for the mechanical limitations of the throttle. You can set 5000 Ohms at the actual rest position and 0 Ohms at the actual end point. These settings are essential for the operation of the throttle.

- Find the ProBit screens for the throttle minimum.

- Leave the throttle in its rest position. The ProBit will give you the reading for throttle position.

- Using the Probit set the throttle minimum to a few percentage points **higher** than the reading you were given. This extra allowance makes up for occasional sluggishness.

- Now find the ProBit screens for throttle maximum.

- Push the throttle to its full on position and hold it there for a few seconds. While you are holding it at full, take the reading for the throttle position.

- Now set the throttle maximum a few percentage points **lower** than the reading. This decrease will allow you to get to full voltage even if the throttle is occasionally sluggish.

2. Motor Levels

The motor levels allow you to use the various lift switches (e.g. lift, tilt, reach, side-shift, etc.) to control the motor output (i.e. the amount of voltage the motor uses to perform the task). These levels can help conserve battery power and save the motor from excessive wear. When you use the motor levels the pump does not have to operate at full voltages for lighter tasks, like tilting.

The preset values for each motor level are outlined in the *Programmable Parameters* table on page 13.

Using the ProBit, you can change each level to any percentage of full motor voltage. Check in the ProBit's customizing screens for the setting for each level. Remember that when more than one switch is selected at a time, level 1 overrides the other levels; level 2 overrides levels 3 and 4; and level 3 overrides level 4.

For example, let's say you set level 1 at 50 % and then connect level 1 to the tilt switch. Next you connect level 2 to the lift switch and leave it at its setting of 80%. If the driver selects the lift and tilt switches at the same time, the pump motor will supply 50% voltage for both and the lift may not have enough power to operate.

3. Acceleration

Acceleration is set as the amount of time the controller allows for the pump motor to ramp up to full output. You can set this time as short as ¼ sec. and as long as you might conceivably want it (up to 32 sec.). This feature allows you to give the motor a soft start.

4. Throttle Polarity

As shipped the PSE1000/PSE550 is set to work with potentiometers that register 5000 Ohms at rest and 0 Ohms at full speed. Most pots are designed this way. However if you are using a pot with reverse polarity (i.e. 0 Ohms at rest and 5000 Ohms at full) you can set the controller to work in reverse.

- Go to the throttle screens in the ProBit and check the throttle setting at rest. The screen will either say "0 Ohms is rest" or "5000 Ohms is rest".

- If the polarity of the potentiometer is set the way you want it, press OK; otherwise, use the ProBit to reverse the polarity.

CAUTION: If the accelerator has faulty wiring, the system will automatically fail to 5000 Ohms. Therefore, if the wiring comes loose when the polarity is reversed, the lift will jump to full speed.

5. Battery-lift Interlock

The battery-lift interlock is controlled by the TSE1000/TSE550. If you want to use an external gauge you need to turn off the internal monitoring with the ProBit.

C. MANUAL PROGRAMMING

Although the ProBit provides the best way to program a PSE1000/PSE550, you can set the 4 motor level inputs even if you do not have a ProBit. (If you are installing the PSE1000/PSE550 on its own, you must use this technique.) The *white/black* "set-up" wire on the wiring harness is used to create a temporary switch. By opening and closing the switch you can record voltage levels for the various inputs.

1. To Begin

- Wire a temporary set-up switch to the switched side of the key switch.

- Connect the *white/black* wire to the switched side of the temporary switch.

2. Throttle Minimum and Throttle Maximum

Throttles/potentiometers hardly ever work to their full mechanical and electrical potential. Most throttles do not move all the way back to the point where the potentiometer reads 5000 Ohms. In the same way, they cannot be pushed all the way to where the potentiometer reads 0 Ohms. Often 25% or more of the total travel is lost. A motor only reaches full output when the potentiometer reads 0 ohms. So, this loss means the motor will never get all the way to 0 Ohms, and therefore will never reach its full possible speed/voltage.

By programming the PSE1000/PSE550 you can make up for the mechanical limitations of the throttle. You can set 5000 Ohms at the actual rest position and 0 Ohms at the actual end point. These settings are essential for the operation of the throttle.

- Close the set-up switch when the key switch is turned off.

- Turn on the key switch.

- Slowly move the throttle several times between rest and full on. The PSE1000/PSE550 will record the end positions as the throttle minimum and throttle maximum.

- Turn off the key switch.

3. Motor Levels

The motor levels allow you to use the various lift switches (e.g. lift, tilt, reach, side-shift, etc.) to control the motor output (i.e. the amount of voltage the motor uses to perform the task). These levels can help conserve battery power and save the motor from excessive wear. When you use the motor levels the pump does not have to operate at full voltages for lighter tasks, like tilting.

The preset values for each motor level are outlined in the *Programmable Parameters* table on page 13. These values should work for the vast majority of situations, but, if necessary, you set new ones using the steps outlined below.

HINT: You may want to use a volt meter (connected across the pump motor terminals) to measure the exact motor voltage for each level.

Please read through all the steps below before beginning.

- Close the **set-up** switch when the key switch is turned off.

- Turn on the key switch.

- Close the **level 1** switch (the *white/red* wire). The speed/voltage will ramp up slowly.

* When you reach the desired speed/voltage open the **setup** switch. The motor will continue to run at that voltage. If you are not sure exactly how accurate you will be, you should aim high rather than low.

- If the motor has reached the speed/voltage you want, open the **level 1** switch. When the switch is opened the PSE1000/PSE550 records the voltage for level one.

- If you missed the voltage you wanted, close the **set-up** switch again (the level 1 switch will still be closed). This time the motor will automatically ramp **down** slowly.

- When you think you have the right voltage open the setup switch and the motor will continue to run at that voltage. If the motor really is at the speed/voltage you want, open the **level 1** switch. When the switch is opened the PSE1000/PSE550 records the voltage for level 1.

Repeat from the * as needed to reach the desired speed/voltage. The motor voltage will ramp up and down alternately.

- When you have finished, turn off the key switch. Insulate and secure the end of the *white/black* set-up wire.

These steps describe the set-up for **level 1**, but you can use the same steps for any of the levels using the appropriate level wire: *white/brown* for level 2, *white/orange* for level 3 and *white/purple* for level 4.

4. Other Programmable Features

The other programmable features (i.e. acceleration, and throttle polarity) cannot be adjusted manually. The PSE1000/PSE550 are programmed with preset values which will work for the vast majority of trucks.

All these features are programmable with the ProBit, but the ProBit will work only when the pump controller is installed with an TSE1000 or TSE550 drive motor controller.