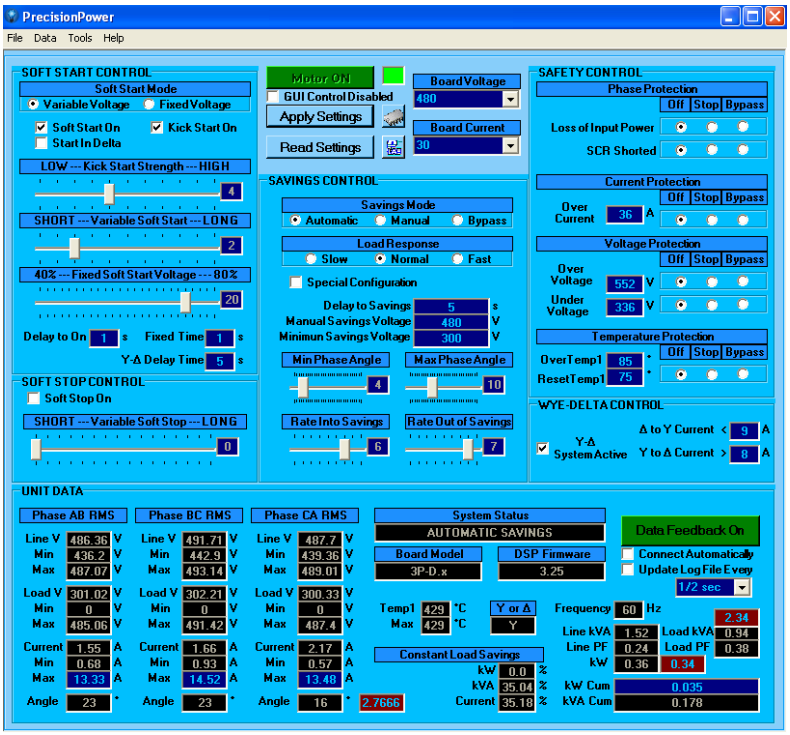
PRECISION
POWER LABS

PrecisionPower Motor Control Software User's Guide

V3.24



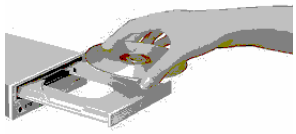
Software Installation Instructions

Minimum System Requirements

- ✓ 233 Mhz processor
- ✓ 64 MB of RAM
- ✓ 10 MB of free disk space
- ✓ Microsoft Windows 98 (or better)
- ✓ Microsoft .NET Framework Version 1.1 (or better) – See Step 2
- ✓ One available RS 232 serial port preferred or a USB serial port. – See Step 4

Installation Instructions

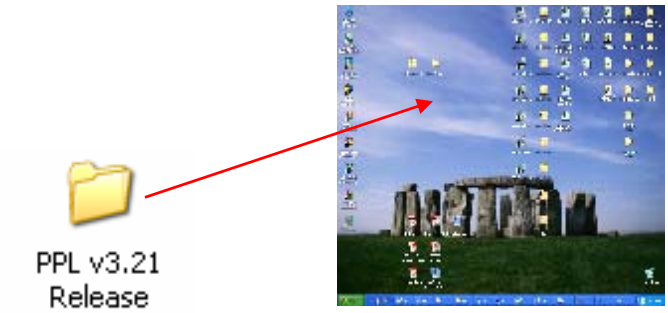
1. Insert **PrecisionPower v3.2X** installation disk into CD Drive and open the drive contents by going to *Start → MyComputer → CD Drive* (typically labeled D:)



2. Install the .NET Framework if not already installed on the computer

Most Windows computers will have the .NET Framework already installed. To determine if the software is preloaded on the computer, open the *Administrative Tools* folder in the *Control Panel* and look for the .NET icons. If the icons are not evident, copy the dotnetfx software from the CD onto the desktop and install the .NET framework.

3. Copy the **PPL v3.2X Release** folder from the disk to some other location such as your C: Drive or your Desktop.

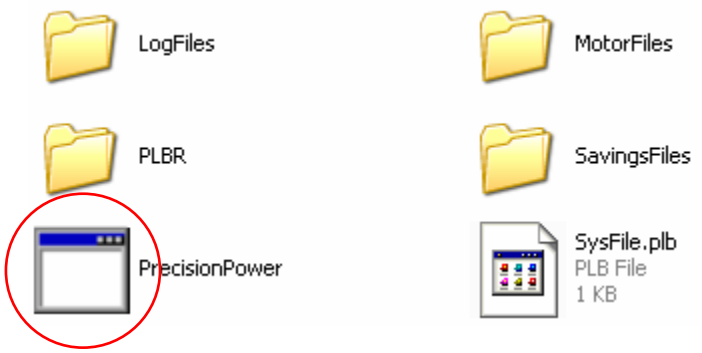


4. If your PC/Laptop does not have an RS232 COM Port the **USB-RS232 Adapter** can alternatively be used with an available USB port.

a) Insert the CD included with the USB 2.0 to RS232 Converter into the CD drive

b) Open the User's guide and follow the installation instructions.

5. Run the PrecisionPower v3.2X software by double clicking the **PrecicionPower** icon located in the PPL v3.2X Release folder that you copied to your PC/Laptop.



6. You will see a progress bar open up as PrecisionPower software loads.

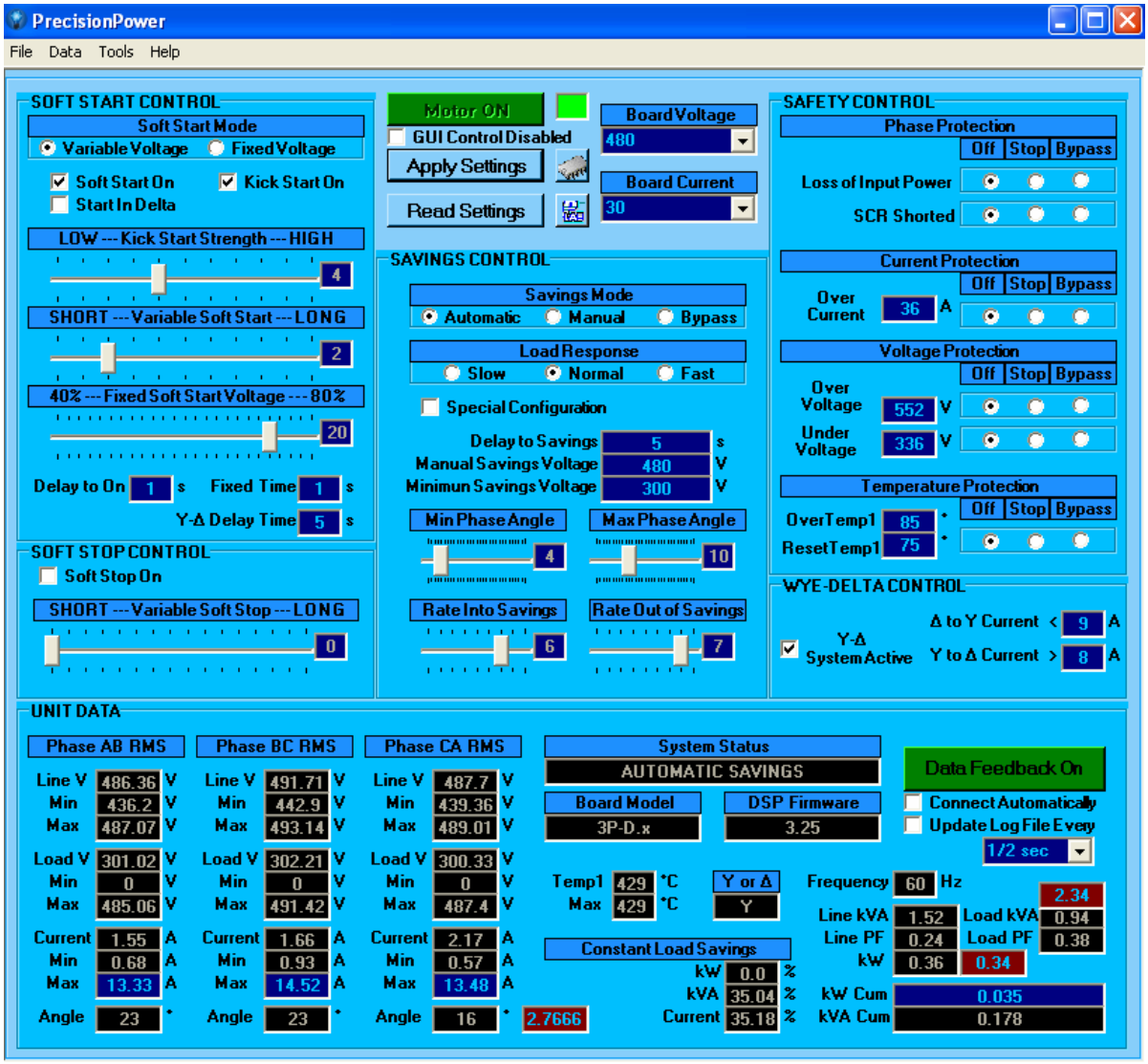
7. Next a security box will pop up and ask you for a password. You can click **Start>>** to start the software at Security Level 0. The default passwords for the PrecisionPower software when you first use it are "security1" and "security2" for Security Levels 1 and 2 respectively. Press **ENTER** to enter the password and then press **Start** to begin the program. Note that to enter characters in the Password window, the text box must first be selected by left-clicking the mouse with the cursor on the text window.

Security Level 0 ➔ Allows user to start and stop the program and to read data values. Adjustments are not accessible.

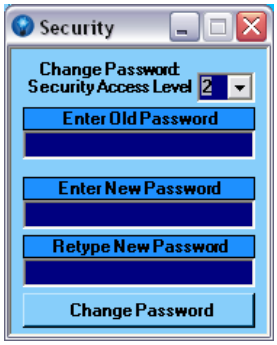
Security Level 1 ➔ Allows user access to Security Level 0 functions and provides capability to clear stored data memory.

Security Level 2 ➔ Allows access to all setup, adjustment and data monitoring features of the software without restrictions.

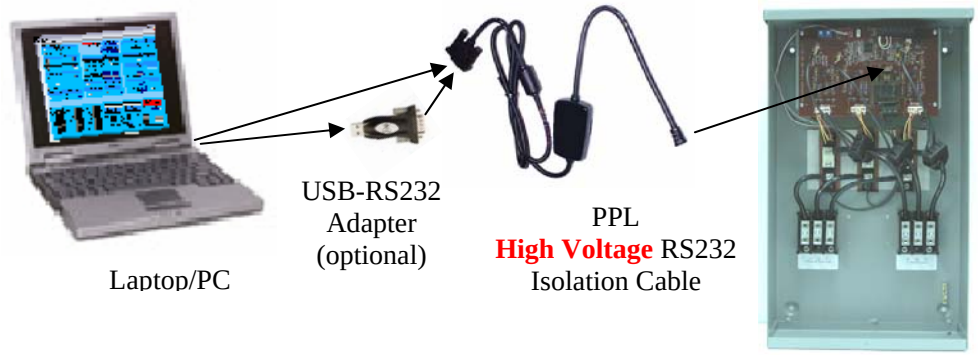
8. Once the program is running, the user interface will open on the PC monitor.



9. The default passwords may be changed using the Security Tool which is accessed from the **Tools → Security** pull-down menu.



Connecting to the IntegraPower ® Controller



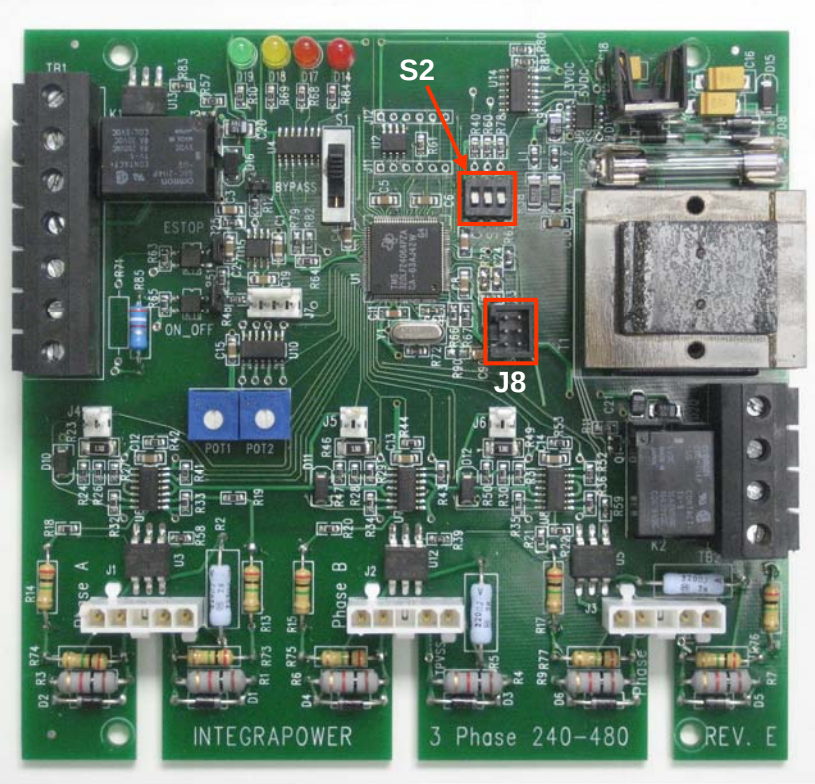
Laptop/PC

USB-RS232 Adapter (optional)

PPL **High Voltage** RS232 Isolation Cable

PPL Motor Controller

- The 9-Pin female connection end of the cable connects to the male RS232 COM Port located on your Laptop (or the USB-RS232 adapter). The 6-pin female connection end of the isolation cable connects to the **J8 Interface Port** located on the **PPL Motor Controller**.
- Make sure that the **Key** on the 6-Pin female connection end of the Isolation Cable is facing towards the *left edge* of the board when you plug it into the Interface Port J8.
- Also make sure the controller is in **GUI Control Mode** by setting the three DIP switch positions down (OFF) on S2. If any of the three switches are up (ON), the PrecisionPower software will be disabled and will not communicate with the controller.



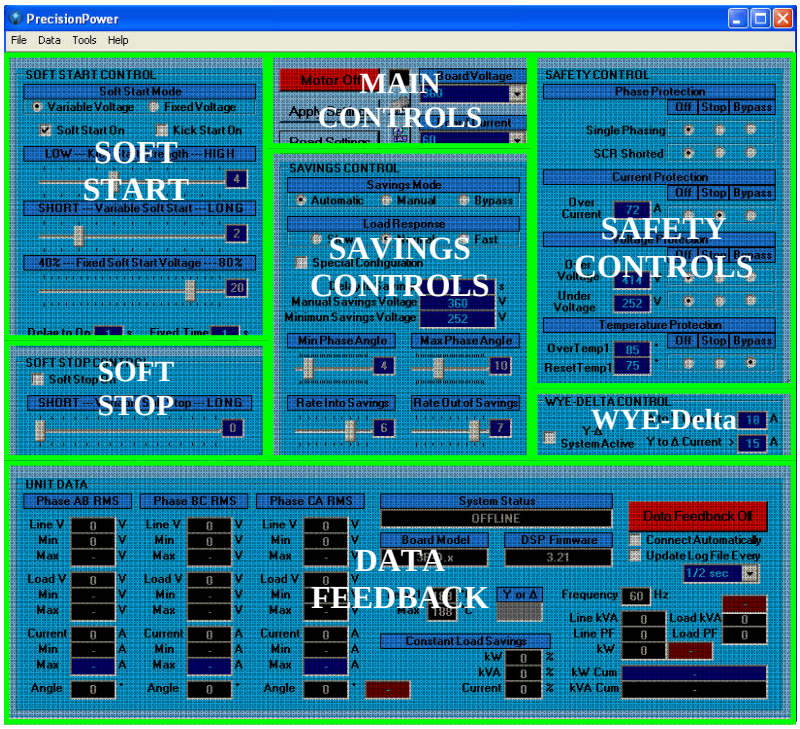
WARNING!!! NEVER attempt to connect to the controller through the Interface connection without the proper Precision Power Labs Isolation Cable. Attempting to do so may result in damage to the controller, personal property, or injury. Also NEVER use an Isolation Cable that is torn or damaged as the damage may be exposing metal that is floating at line voltage.

GUI Control Mode

- In order to activate **GUI Control Mode** and communicate with the IntegraPower® unit all three **DIP Switch (S2)** positions must be down (OFF) BEFORE the unit is powered up. When in GUI Control Mode the motor controller will ignore the settings of the switch S2 and the **Potentiometers (**POT1 and POT2) located on the board. Powering down the board and restarting it with ANY of the switches ON will force the unit into **Board Control Mode** and the software settings will no longer apply.

- When in GUI Control Mode the board will continue to operate normally from the signals available from the **Industrial Control Terminal Block (TB1)**.

PrecisionPower Interface



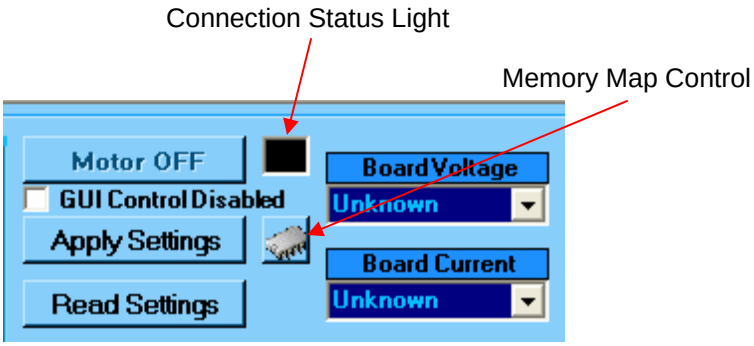
The PrecisionPower software interface implements seven types of functions:

MAIN CONTROL
SOFT START
SOFT STOP
DATA FEEDBACK
SAVINGS CONTROL
SAFETY CONTROL
WYE-DELTA

These features are grouped on the user interface as shown in the figure above. Some additional features are available from the pull-down menus at the top left.

Text boxes with blue backgrounds indicate data values that can be entered by the user. Text boxes with a black background indicate data values that can be read only.

Main Control



Connection Status Light – the color determines the status of the connection between the PrecisionPower software and the board.

BLACK - indicates NO signal between board and software.

DARK GREEN - indicates a GOOD signal, and the motor is not running

LIGHT GREEN - indicates a GOOD signal and the motor is running.

RED - indicates a GOOD signal but the unit has detected a fault during operation.

BLUE - indicates a BAD signal possibly caused by a faulty cable connection (or possibly by the USB-RS232 adapter).

Board Voltage - should be set to match the voltage rating of the board.

Board Current - should be set to match the current rating of the board.

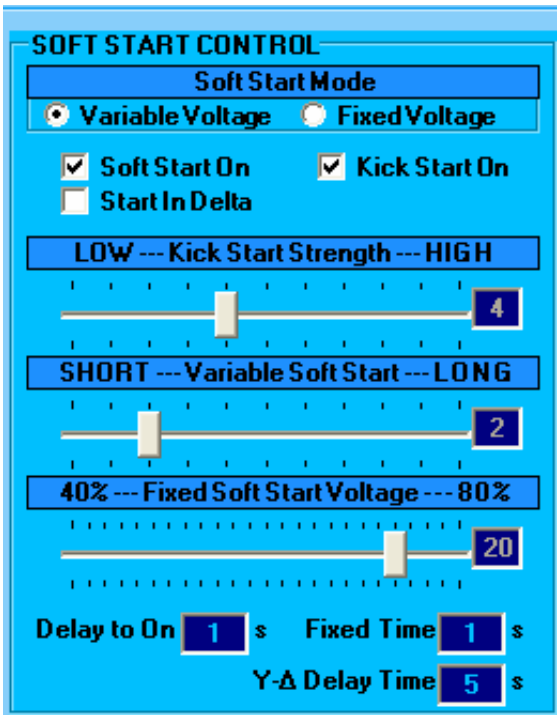
Apply Settings - used to apply all settings to the memory on the board (thus saving/overwriting all the settings). **NOTE** - NO settings will be applied unless you click Apply Settings after you have changed them.

Read Settings - used to read the settings from the memory on the board.

Memory View - views on-board memory (for initializing only).

GUI Control Disabled – When this check-box is selected, the motor can be turned ON and OFF using the **Motor On / Motor OFF** control button. If the check-box is not selected, the motor will receive ON and OFF signals from Terminals 6 and 7 on TB1 (or equivalently, by having the ON-OFF jumper in place). **Note** that even with the check-box selected, the external E-Stop (emergency stop) is still enabled and will be able to turn the motor OFF (assuming the E-Stop jumper is not in place to disable this feature).

Soft Start Controls



Soft Start Mode –

Variable Voltage – ramps the voltage from an initial voltage up to a final voltage that is determined by the controller. Recommended for most circumstances.

Fixed Voltage – ramps the voltage from an initial voltage up to a final voltage that is specified by the user. This voltage plateau will be maintained for a time duration established by the Fixed Time data field.

Soft Start On - enables the soft start if checked. If this is not checked, the full line voltage will be applied at once.

Kick Start On - enables kick start if checked. The kick start increases the initial voltage level from which the soft start begins its voltage ramp. Use for added starting torque if necessary.

Start In Delta (Applies only to Y-Δ Operation) – forces motor to start in the Delta stator winding configuration. This feature is provided for starting heavy loads that may otherwise overload the motor in a Y-winding configuration. Once started, the changeover from Δ to Y is computer controlled. The electronic voltage ramp soft start functions normally in this mode.

Kick Start Strength - increases or decreases the initial kick voltage start level and then it continues the ramp to full voltage.

Variable Soft Start - increases or decreases the duration of the variable soft start.

Fixed Soft Start Voltage – establishes the maximum voltage (expressed as a percentage of full voltage) to which the soft start will ramp. This feature is enabled only if Fixed Voltage Soft Start Mode is selected.

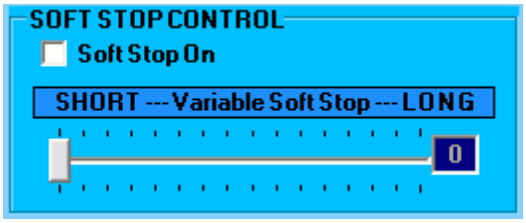
Delay to On – A time delay after the start signal has been received before the controller will begin the soft start ramp. A value of zero represents no delay.

Fixed Time – If the Fixed Voltage Soft Start Mode is selected, the user specified plateau voltage will be held for the number of seconds entered in the Fixed Time data field.

Y-Δ Delay Time (Applies only to Y-Δ Operation) **–** Forced time delay prior to switching from Y to Δ winding configurations at initial start-up. This allows time for the motor to come up to speed before attempting to change winding configurations. The time delay depends on the mechanical load and desired start profile of the motor.

Helpful Hint – Turn Variable Voltage Soft start on with Kick start on. Start with a rather low kick and short soft start, adjusting while monitoring the current profile.

Soft Stop Control



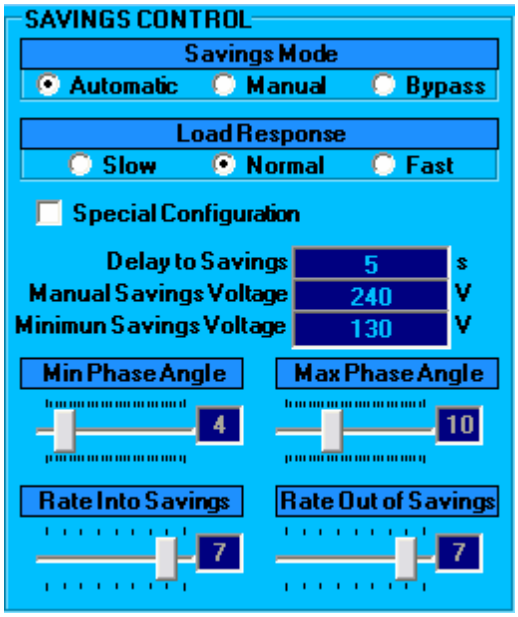
This is often used with water pumping systems to slow down the flow rate before turning off. In most normal circumstances, use of this feature is not recommended. To use the Soft Stop Control feature, control power cannot be supplied directly from the AC line power – it must be derived from a separate control power source (24VAC, 110VAC or 240VAC)

Soft Stop On - if checked this enables the soft stop. The soft stop will reduce the voltage to the motor until instability (or current rise) is detected. After the unit detects this, it shuts off completely (recommended off).

Variable Soft Stop - this slider will increase the time it takes for the soft stop to reduce the voltage to the motor extending the soft stop time.

Warning!!! Turning the soft stop on disables the ability to immediately turn off a motor through the IntegraPower controller. Do NOT use the soft stop in any application where the stop signal to the IntegraPower controller might be used for emergency stops.

Savings Control



Savings Mode –

Automatic – the controller automatically adjusts the output power to the motor to optimize energy savings under static or variable loading. In most circumstances, the Automatic Savings Mode is recommended.

Manual – The controller will maintain a user-specified output voltage to the motor.

Bypass – All three SCR switches are turned on continuously. This establishes an "electronic bypass" condition, where the motor receives full line voltage.

Load Response – Determines how abruptly and to what extent the controller will come out of Automatic Savings Mode (by applying more power to the motor) in response to an applied mechanical load.

Slow – use this setting if the load variations tend to be small or slowly varying

Normal – start with this setting as the default

Fast – use this setting if the load variations tend to be large or change abruptly.

Special Configuration - the controller will run in "Special Configuration" if checked. The Special Configuration mode will output full power to the motor once the controller receives power, and then invoke the savings algorithm once a start signal has been received. The controller recognizes the start signal from Terminals 6 and 7 of TB1 or, alternatively, if the On/Off jumper is in place. This feature is often used with another soft starter that, once it has implemented its start sequence, will then send a "Start" signal to the IntegraPower controller to commence energy savings.

Delay to Savings - after the controller starts (or soft starts) it will run in Electronic Bypass for the user-specified time period (in seconds) before going into savings.

Manual Savings Voltage - establishes the fixed manual savings voltage.

Minimum Savings Voltage - sets the minimum attainable savings voltage in the Automatic Savings Mode.

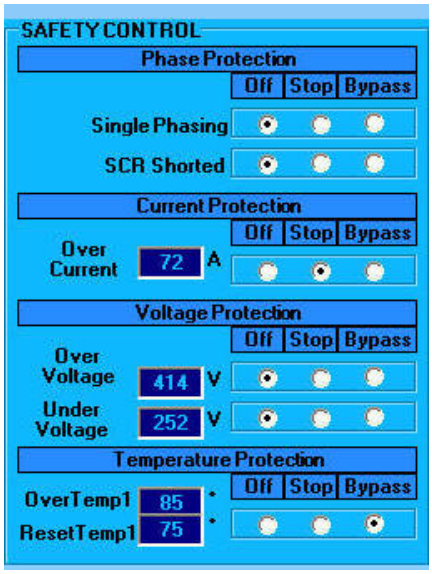
Min Phase Angle - sets minimum target phase angle (advanced).

Max Phase Angle - sets maximum target phase angle (advanced).

Rate Into Savings - increases (right) or decreases (left) the speed of the rate into savings.

Rate Out of Savings - increases (right) or decreases (left) the speed of the rate out of savings.

Safety Controls / Fault Detection



The controller monitors several potential fault conditions that can affect the motor or the controller itself. The Safety Controls allow the user to customize fault threshold detection levels and to determine what action should be taken in the event a fault is detected.

For each of the monitored fault conditions, the user can select one of the three actions the controller will implement if a fault is detected:

Off – Ignore the fault. Red LED will not illuminate.

Stop – Detection of the fault condition will cause the controller to stop the motor and the Red LED will illuminate.

Bypass – Detection of the fault condition will cause the

controller to run in electronic bypass (full power to motor, no savings). The Red LED will illuminate.

Additionally, some of the fault conditions allow the user to provide a threshold detection level, which is entered in the blue text box. The default values may be edited as needed.

Single Phasing - Response time 5-10 seconds (1 second during soft start).

SCR Shorted - the controller can detect a shorted SCR and take action. Operational at all times. Response time 8-10 seconds. (1 second during soft start).

Over Current - the controller can detect over current based on set value. Response time 0-15 seconds.
Over Voltage - the controller can detect over voltage based on set value. Response time 0-15 seconds.

Under Voltage - the controller can detect under voltage based on set value. Response time 0-15 seconds.

Over Temp 1 - detects temperature from temp sensor 1. If the selected action is Bypass, the controller will continue normal operation once Reset Temp 1 is reached.

WYE – Delta Control

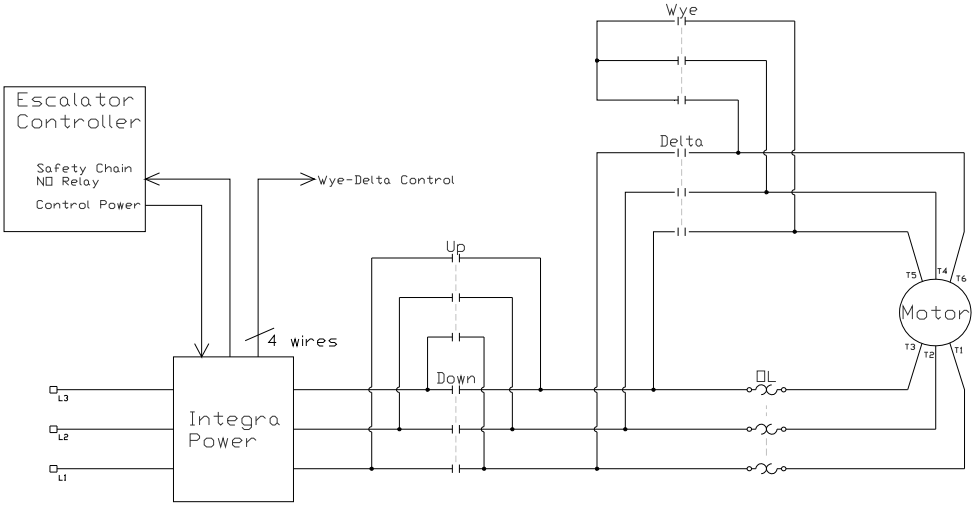
The Y-Δ control provides an additional means to reduce energy consumption by allowing the motor to *run* in the Y-configuration when operating conditions allow. In this mode, the computer controls mechanical contactors that switch between Y and Delta stator winding configurations. The Y-Δ energy saving method works in conjunction with the voltage reduction method that is implemented using the SCR switches. Under the best circumstances, both voltage reduction and Y-Δ switching are used together to deliver the maximum energy savings. The IntegraPower controller is the only device that provides this unique capability to combine these two different savings methods.

This feature can only be accessed using the PrecisionPower software interface. It is enabled by selecting the **Y-Δ System Active** check-box. The 4-position **switch S2** (located on the control board) must be in **position 2**. Relay K1 is then controlled by the Y-Δ control program.

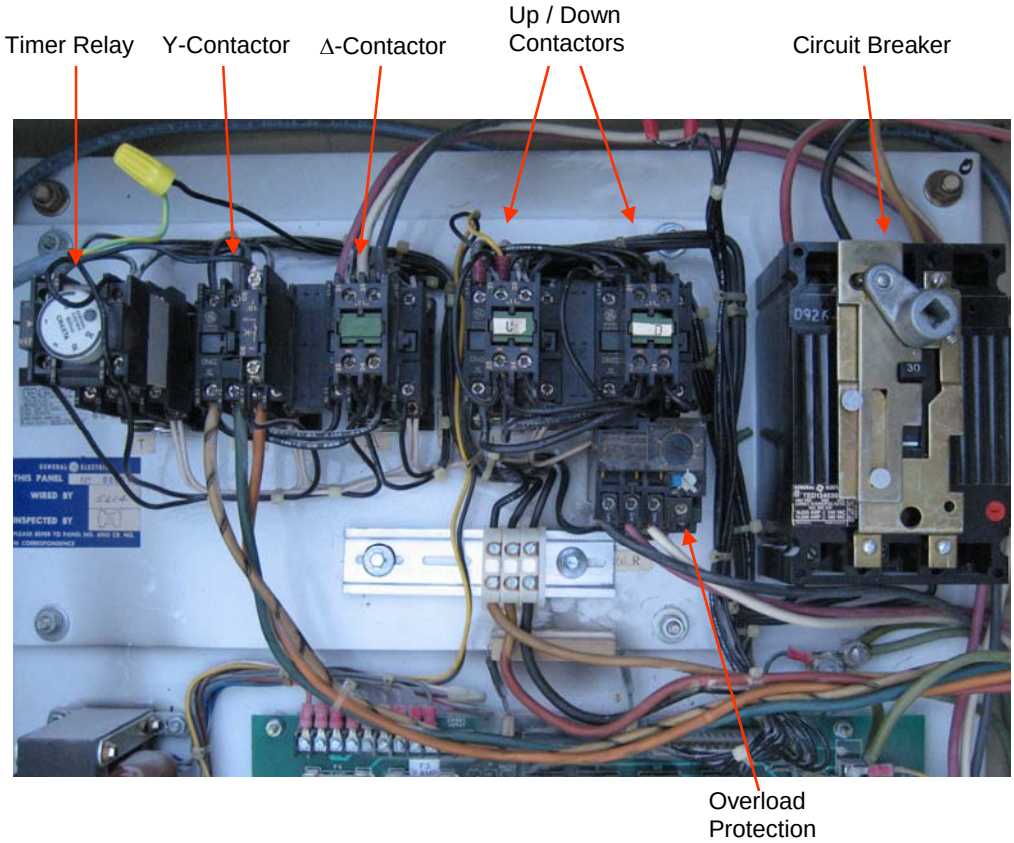
While the Wye-Delta Control can be applied to other motor winding configurations, Wye-Delta switching is the most common and will only be discussed here for clarity. Please consult your local rep for assistance with other suitable applications of this control feature.

The most typical application consists of retrofitting or upgrading an existing Wye-Delta soft starter with the IntegraPower Wye-Delta Control. In that case, it is assumed that the motor is designed for Wye-Delta operation and that external mechanical contactors are already available as part of the motor control circuit. The motor may have 6 or 12 leads, but in either case the mechanical contactors will assume one switched state for Wye operation and a second switched state for Delta operation. Control of the external mechanical contactors is accomplished with connections to TB1: Terminals 1 and 2 of TB1 control the Wye contactor(s), whereas Terminals 3 and 4 of TB1 control the Delta contactor(s). An internal safeguard is built into the IntegraPower controller to prevent Terminals 1-2 closing at the same time as Terminals 3-4. If Terminals 1-2 are closed, then Terminals 3-4 are open, and vise verse.

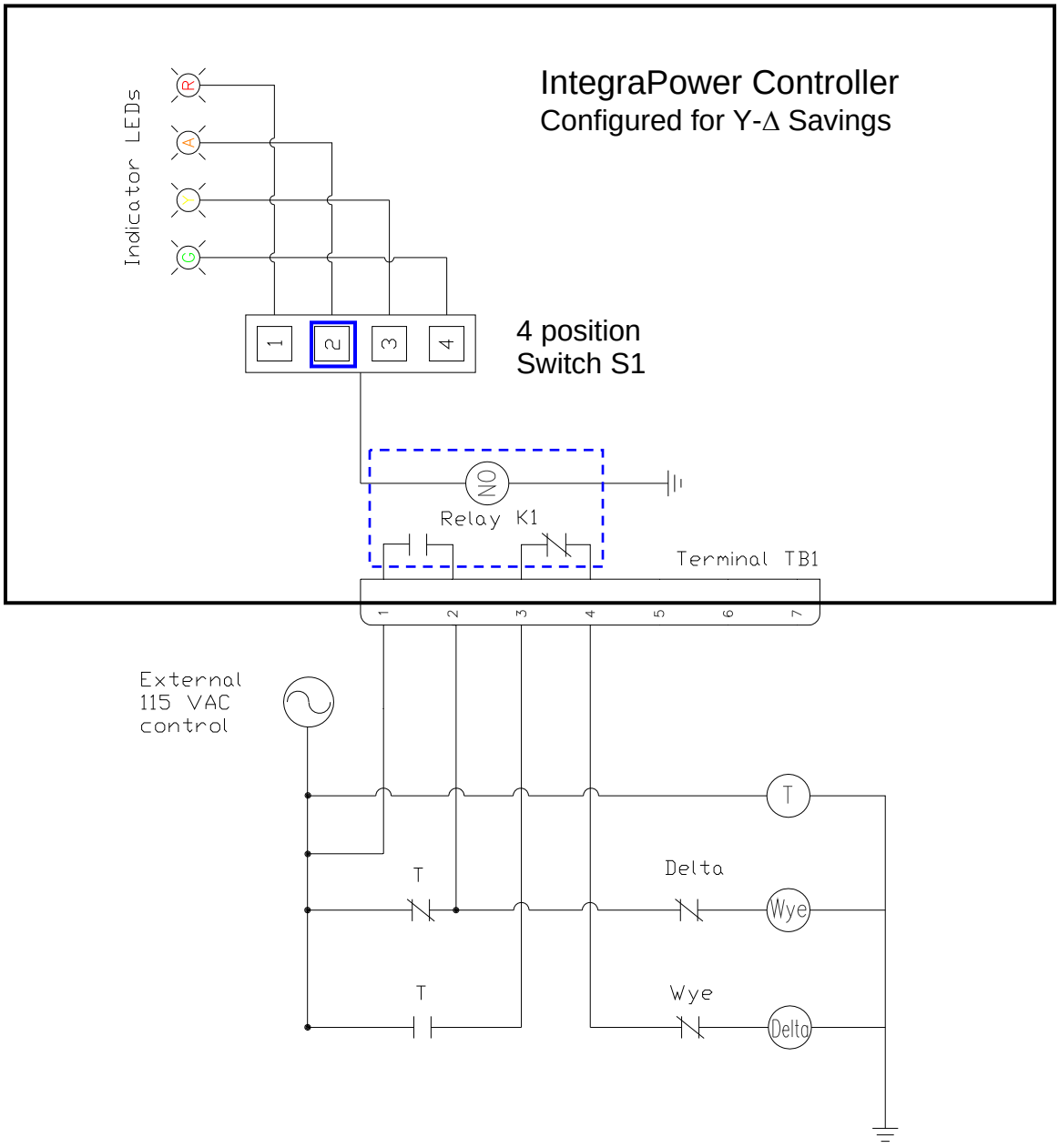
The following two figures show a typical Y-Δ soft starter on an escalator. The first figure is a schematic wiring diagram that shows how mechanical contactor are used to implement Y and Delta stator winding configurations as well as UP and DOWN operation. Also shown is the IntegraPower controller, as it interfaces with the existing escalator system. Note the four wires (from TB1) that are used to control the Y-Δ switching. The IntegraPower is normally connected just before (as shown) or immediately after the Up / Down contactors. The second figure is a photograph of the Y-Δ components. In the case of an escalator, these components are usually found inside the escalator controller.



Typical Y-Δ Control Components



The figure below shows how the external mechanical contactor coils are connected to the IntegraPower controller to implement Y-Δ control. Note that S1 must be in position 2 and that optional Relay K1 must be plugged into its socket on the control board. The four connections to TB1 should be made exactly as shown in the figure. Under Y-Δ control, the computer will actuate Relay K1 in response to mechanical loading on the motor and thereby control switching between Y and Δ configurations. It is recommended to simply leave the timer relay (T) intact in the control circuit as shown.



External Y-Δ switching circuit
(showing contactor coils)

The IntegraPower Wye-Delta Control relies on user-defined load current threshold values to control the switching of the mechanical contactors. A lower current threshold value defines the transition from **Y to Δ** and a second higher current threshold value defines the reverse transition from **Δ to Y**. Some experimentation is normally required to optimize these two settings. Initially, target the **Y to Delta** (lower) threshold to be the current at which the motor becomes moderately loaded *when operating in the Y-configuration*. You may do this by monitoring the power factor in the Y-mode and note the load current when the power factor is about 0.60. This will serve as an initial guess. The **Delta to Y** threshold can also be initially set at the current level that corresponds to a 0.60 power factor *when the motor is operating in the Δ-configuration*. In this latter case, the current will be higher than the first threshold value by virtue of the motor operating in the Δ-configuration. These two settings typically differ by 0.5 to 1.5 Amps – perhaps 3.5A for the Y to Delta setting and 4.5A for the Delta to Y threshold for a 10hp escalator motor. However, these may vary, depending on the particular motor and load.

The initial current threshold settings may be optimized by considering the following points:

1. More energy savings will result from Y-mode operation – as opposed to operation in Delta mode. To increase the available savings, the **Y to Delta** threshold is increased to favor operation in the Y-mode.

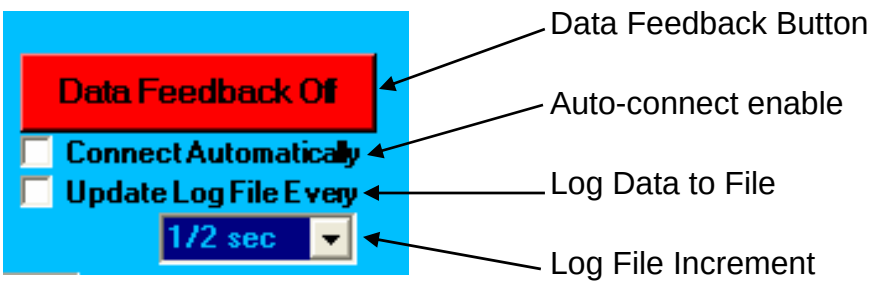
2. Similarly, it is desirable to set the **Delta to Y** threshold as high as possible so the motor switches back to Y-mode operation at the earliest opportunity. This will maximize the available savings.

3. However, if this upper threshold is set too high (i.e., too close to the lower threshold value) the controller may oscillate between Y and Δ modes or may switch back and forth too frequently. In this case, the controller will transition back to the Y-mode at a point very near to, or even above the lower threshold value, such that the controller immediately switches to the Δ-configuration. This will cause excessive wear on the contactors and should be avoided.

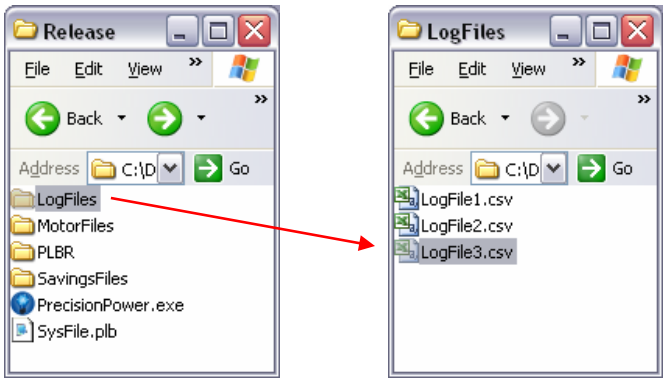
4. Less motor torque is available in the Y-mode. If the motor appears to slow or lag as it becomes more heavily loaded in the Y-mode, the **Y to Delta** threshold should be reduced so the motor switches to the Δ-configuration with less load.

5. In general, it is more conservative to set both the **Y to Delta** and **Delta to Y** thresholds at lower values (while making the Delta to Y setting about 1.0A greater than the Y to Delta threshold), but more savings can be obtained by making the set-points higher. Optimizing this tradeoff requires some experimentation.

Data Feedback



Data Feedback Button - by pressing this button and changing it to “Data Feedback On” it will start to retrieve data from the controller and display it in the Data Feedback display fields. The data retrieved is real time data.
Update LogFile Every - if this box is checked and the Data Feedback is on, the PrecisionPower software will record the real time data to an Excel file. When the box is unchecked or the Data Feedback is turned off, the recorded data will automatically get saved in a LogFile#.csv in the **LogFiles** folder in the software base directory. The file is automatically named with the first available number and has start and stop times recorded in the file.



FileLog Increment – this dropbox controls how often the data is logged to the LogFile. The Data Feedback updates every 1/2 second as the default, but you can increase the data logging time interval to encompass longer record times.

Connect Automatically – the computer will automatically re-establish a communications link if lost during data acquisition. This may happen if the motor is turned off or if there is a loss of power.

Note: Using the LogFile to record and store real-time data as described above, requires that the PrecisionPower software interface be directly connected to the IntegraPower controller via the Isolation Cable. Presently, large files that contain high-resolution data may only be acquired with this method. An add-on memory card is presently in development that will allow 30 days of real time data to be collected and stored on-board for later retrieval. This enhanced memory card is expected to be available in the second half of 2008. Check with your dealer for availability.

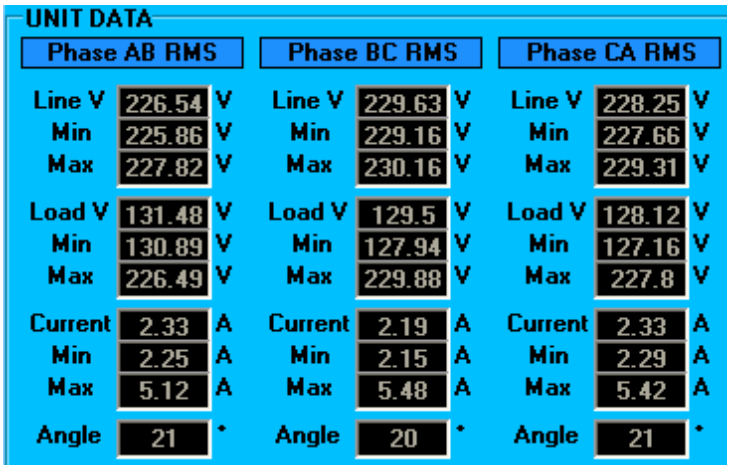
Voltage, Current, and Phase Angle readout

Line V – phase-to-phase voltage measured on the input side of the controller

Min Line V – minimum line voltage that the software has detected since data feedback was turned on

Max Line V – maximum line voltage that the software has detected since data feedback was turned on

Load V – phase-to-phase voltage measured on the output (motor) side of the controller. Note the Load V may



be much less than the Line V when the controller is in savings mode.

Min Load V – minimum load voltage that the software has detected since data feedback was turned on

Max Load V - maximum load voltage the software detected since data feedback was turned on

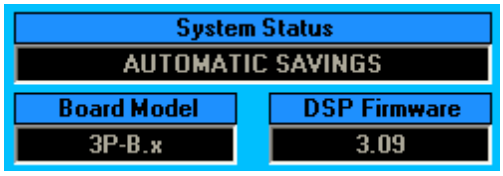
Current – measured line current. **NOTE -** zero current may show up as some small amount of current due to noise in the circuitry.

Min Current - minimum line current the software detected since data feedback was turned on

Max Current - maximum line current the software detected since data feedback was turned on

Angle - the measured phase angle between the voltage and the current waveforms on a given phase leg. **NOTE -** phase angle measurements are only accurate during savings mode.

System Status



System Status – the current system status is displayed in this window. These messages are also recoded with the log file data to aid diagnostic analysis and trouble-shooting.

The following system status messages may appear:

OFFLINE - software is not connected to unit.

ONLINE - software is connected, but motor is not running.

DELAY TO START - unit is delaying start of motor.

SOFT STARTING - unit is soft starting

ELECTRONIC BYPASS - unit continuously firing all 3 SCRs.

MANUAL SAVINGS - unit is in manual savings mode.

AUTOMATIC SAVINGS - unit is in auto savings mode.

SOFT STOPPING - unit is in soft stop mode.

ERROR: OVER TEMPERATURE - unit detected over temp.

ERROR: OVER CURRENT– unit detected high current.

ERROR: OVER VOLTAGE - unit detected high line voltage

ERROR: UNDER VOLTAGE - unit detect low line voltage

ERROR: SINGLE PHASE - unit detected general single phasing

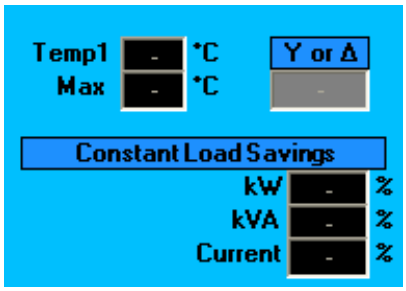
ERROR: SCR SHORT - unit detected an SCR short

ERROR: LINE LOSS - unit detected loss in line current

Board Model - displays the model number of the detected control board.

DSP Firmware - displays the firmware version in the DSP.

Temperature



Temp1 – displays the temperature of the b-phase SCR module housing.

Max Temp1 - maximum Temp1 detected since the Data Feedback was turned on.

Y or Δ

When the **Y-Δ System Active** check-box is selected, the **Y or Δ** window will indicate which winding configuration is presently active. This display is updated in real time.

Constant Load Savings

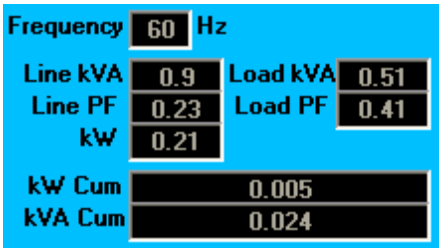
Constant Load Savings – shows approximate kW, kVA and current % savings in real time. The baseline (no savings) power consumption parameters are first recorded when the controller transitions from Electronic Bypass into the Savings mode. Subsequent real time measurements are compared to this recorded baseline value and the results displayed as % savings in the data fields. These approximate savings calculations are fairly accurate as long as the motor load remains constant. Otherwise, the "calibration" may be repeated by forcing the controller into Electronic Bypass and then back into Automatic Savings.

kW - a comparison between the present kW and the kW snapshot taken when the controller switched from Bypass to Savings.

kVA - a comparison between present kVA and the kVA snapshot taken when the controller switched from Bypass to Savings.

Current - a comparison between the present Current and the Current snapshot taken when the controller switched from Bypass to Savings.

Power Consumption



Frequency - the line frequency is automatically detected and displayed (50Hz or 60Hz)

Line kVA - the calculated kVA on the line side of the unit. **NOTE** - line side kVA is what you want to use when calculating savings as this is what the utility sees.

Load kVA - the calculated kVA on the load (motor) side of the unit.

Line PF - the calculated power factor on the line side of the unit. **NOTE** - line side power factor is what you want to use when calculating savings as this is what the utility sees.

Load PF - the calculated power factor on the load side of the unit.

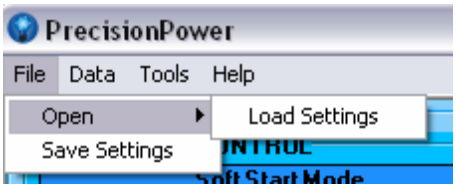
kW - the measured kW consumption. kW is measured by directly sampling voltage and current values at a rate of 18,000 times per second (50Hz) or 21,600 times per second (60Hz)

kW Cum - the cumulative kW since the Data Feedback was turned on.

kVA Cum - the cumulative line side kVA since the Data Feedback was turned on.

Menu Items

File



Load Settings - loads a settings file that has previously stored settings.

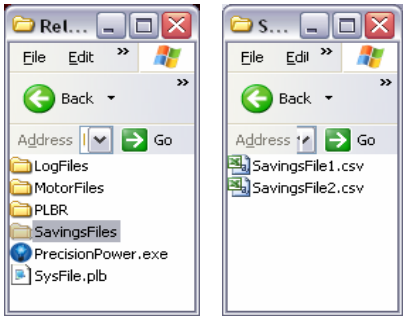
Save Settings - saves the current settings into a file that can be re-loaded later.

Data

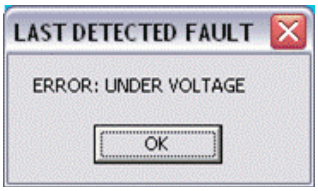
Clear All Data - clears ALL of the onboard memory and resets ALL default settings based on the **Board Voltage** and **Board Current** (located in Main Controls).

Read Stored Savings - reads out the voltage tracking numbers that the unit has been storing on the onboard memory. It will also ask if you want to clear them out. Savings files are automatically named and saved in the **SavingsFiles** folder.

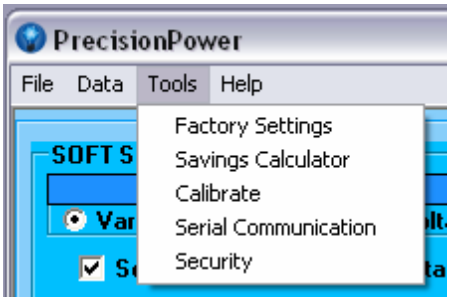
Reset Stored Savings - clears the voltage tracking numbers stored in the onboard memory. Voltage tracking numbers will fill memory in a minimum time of 45 days. They should be cleared if more tracking time is needed.



Last Detected Fault - the unit will record the last detected fault on the onboard memory. This can be used to retrieve the last fault.



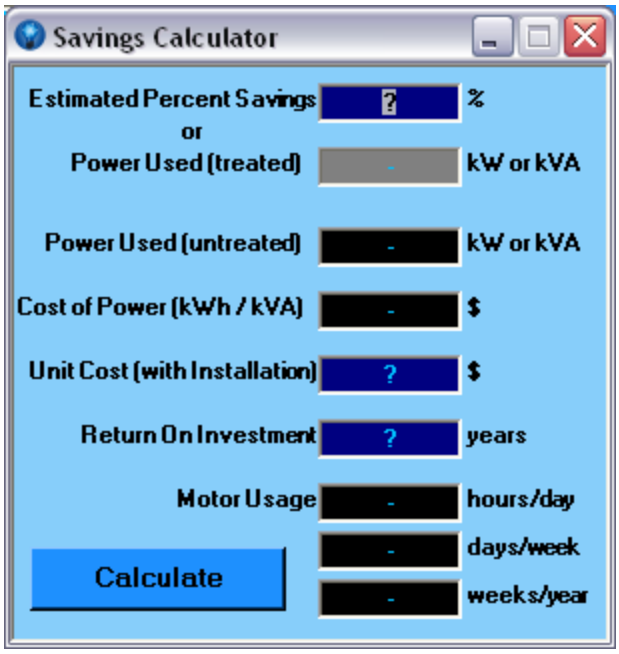
Tools



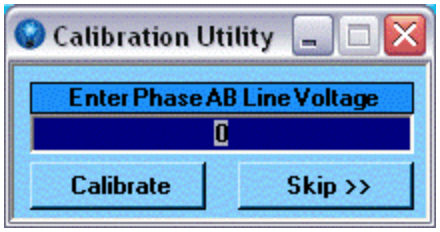
Factory Settings – retrieves the default settings based on the **Board Voltage** and **Board Current** (located in Main Controls). After the settings are automatically changed you must **Apply Settings** to memory.

Savings Calculator - opens a savings calculator that can be used to estimate savings and to calculate Return On Investment.

Fill in the black data fields with the requested information and leave a question mark "**?**" in the field you want to calculate. Then click the Calculate button. Hovering over **Power Used (treated)** or **Estimated Percent Savings** will let you switch between one or the other ("treated" means "with the IntegraPower unit" and "untreated" means without the IntegraPower unit).

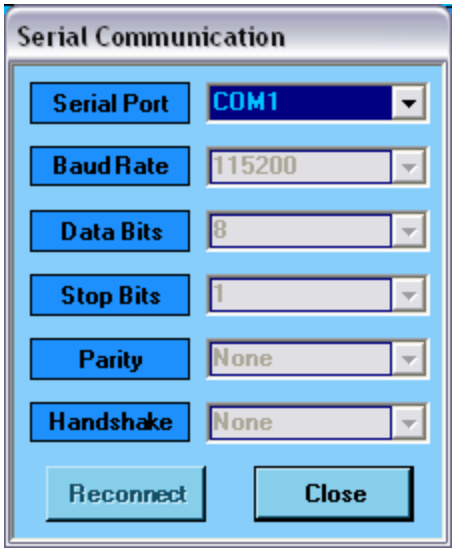


Calibrate – is a tool that can be used to calibrate line voltage, load voltage, current, and kW readings. It is highly recommended to calibrate the controller to obtain the best accuracy of the displayed, stored and calculated parameters.



To use the calibration utility, you need some other measuring device (such as a Fluke 434). With the motor running and controller in Savings mode, turn the Data Feedback on and then open the Calibration Utility. Use the other measuring device to enter calibration numbers into the fields as requested. Then click **Calibrate**. The software will calculate calibration numbers and then store them in the onboard memory of the controller. If calibration is not needed for a certain field, just click **Skip>>**.

Serial Communication - a tool used to switch the COM port that is used to connect to the unit via the Isolation Cable.



If using a PC or Laptop with multiple COM ports or virtual COM ports (as with the USB-RS232 adapter) you may need to tell the PrecisionPower software which COM port to use. The available COM ports are already detected by the software and placed in the **Serial Port** drop down box. By changing the COM port number in the Serial Port drop down box the software will automatically re-connect to that COM port. Click Close when finished.

Security - a tool that changes the password protection.

Help

About - opens the about window for the PrecisionPower software (where you can find the version of your software).