A2110E

Motor Controller

Operating Instruction Manual



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Preface

Related Instructions

The following publications are also included to further your understanding of this instrument and its component parts:

Part No.	Description
201M	*Limited Warranty*
554M	*CD for A2110E Controller*

Scope

These instructions cover the installation and operation of Model A2110E Motor Controller as used with Laboratory Reactors and Pressure Vessels. The users should study the instructions carefully before using any of these controllers so that they will fully understand the capabilities of this equipment and the safety precautions to be observed in its operation.

Applications

These units are designed specifically for use with reactors and pressure vessels and are to be used only with equipment.

Explanation of Symbols

I	On position
O	Off Position
~	Alternating Current (AC)
	This **CAUTION** symbol may be present on the Product Instrumentation and literature. If present on the product, the user must consult the appropriate part of the accompanying product literature for more information.
	**Protective Earth (PE) terminal.** Provided for connection of the protective earth (green or green/yellow) supply system conductor.

Safety Information

To avoid electrical shock, always:

1. Use a properly grounded electrical outlet of correct voltage and current handling capability.
2. Ensure that the equipment is connected to electrical service according to local national electrical codes. Failure to properly connect may create a fire or shock hazard.
3. For continued protection against possible hazard, replace fuses with same type and rating of fuse.
4. Disconnect from the power supply before maintenance or servicing.

To avoid personal injury:

1. Do not use in the presence of flammable or combustible materials; fire or explosion may result. This device contains components which may ignite such material.
2. Refer servicing to qualified personnel.

Intended Usage

This controller has been designed for use with Pressure Vessels and Reactors. It has been designed, built, and tested to strict physical and electrical standards. However, it is the user's responsibility to install and operate it in conformance with local pressure and electrical codes.

If the instrument is used in a manner not specified by Company, the protection provided by the equipment may be impaired.

Cleaning & Maintenance

Periodic cleaning may be performed on the exterior surfaces of the controller with a lightly dampened cloth containing mild soap solution. All power should be disconnected and the power cord should be unplugged when cleaning the A2110E Controller.

There are no user serviceable parts inside the product other than what is specifically called out and discussed in this manual. Advanced troubleshooting instructions beyond the scope of this manual can be obtained by calling Company in order to determine which part(s) may be replaced or serviced.

General Specifications

Electrical Ratings

115VAC, 8.0 Amps, 50/60 Hz
or
230VAC, 8.0 Amps, 50/60 Hz

Before connecting a controller to an electrical outlet, the user must be certain that the electrical outlet has an earth ground connection and that the line, load and other characteristics of the installation do not exceed the following limits:

Voltage: Fluctuations in the line voltage should not exceed 10% of the rated nominal voltage shown on the data plate.

Frequency: Controllers can be operated from either a 50 or 60 Hertz power supply without affecting their operation or calibration.

Current: The total current drawn should not exceed the rating shown on the data plate on the controller by more than 10 percent.

Environmental Conditions

This instrument is intended to be used indoors.

Operating: 15 °C to 35 °C; maximum relative humidity of 80% non-condensing. Installation Category II (over voltage) in accordance with IEC 664.
Pollution degree 2 in accordance with IEC 664.

Altitude Limit: 2,000 meters.

Storage: -25 °C and 65 °C; 10% to 85% relative humidity.



Caution!
Do not use in hazardous atmospheres.

Provisions for Lifting and Carrying

Before moving the instrument, disconnect all connections from the rear of the apparatus. Lift the instrument by grabbing underneath each corner.

User's Responsibility

All Reactors and Pressure Vessels are designed and manufactured with great care to assure safe operation when used within their prescribed temperature and pressure limits.

But... the basic responsibility for safety when using this equipment rests entirely with the user; who must:

1. **Select a reactor or pressure vessel** that has the capability, pressure rating, corrosion resistance, and design features that are suitable for its intended use. Company engineers will be glad to discuss available equipment and material options with prospective users, but the final responsibility for selecting a reactor or pressure vessel that will perform to the user's satisfaction in any particular reaction or test must rest with the user.

   In exercising the responsibility for the selection of pressure equipment, the prospective user is often faced with the choice between over or under-designed equipment. The hazards introduced by under-designed pressure vessels are readily apparent, but the penalties that must be paid for over-designed apparatus are often overlooked. Recognizing these criteria, reactors and pressure vessels are offered in several different styles, each designed for convenient use in daily operation within certain temperature and pressure limits, using gaskets, closures, and other elements carefully selected for safe operation within the limits specified for that design. But in order to preserve the validity of these designs, all temperature and pressure limits must be observed, and no attempt should be made to increase these limits by making alterations or by substituting components which are not recommended by Company.

2. **Install and operate** the equipment within a suitable barricade, if required, with appropriate safety accessories and in full compliance with local safety codes and rules.

   All standard pressure vessels are provided with either suitable relief device or a means to attach one (typically in the form of a plugged opening). When a pressure vessel is delivered without a pressure venting device, it is the customer's responsibility to provide pressure relief in order to protect the operator and the equipment from destructive high pressures. If you need more information or need help in selecting a proper relief device, please contact Company.

3. **Establish training procedures** to ensure that any person handling the equipment knows how to use it properly.

4. **Maintain the equipment** in good condition and establish procedures for periodic testing to be sure the vessel remains structurally sound.

Unpack Carefully

Unpack the equipment carefully and check all the parts against the packing list. If shipping damage is discovered, report it immediately to the delivering carriers. Examine the components closely for any loose parts or shipping damage and be sure to check all layers of packing materials thoroughly so as not to overlook any parts which might otherwise be discarded.

Installation

General Instructions

Set the controller near the reactor on a sturdy bench or table where there is convenient access to an electrical outlet capable of carrying the appropriate current. Leave a space of at least twelve inches between the controller and the reactor so that the controller will not be affected by radiant heat.

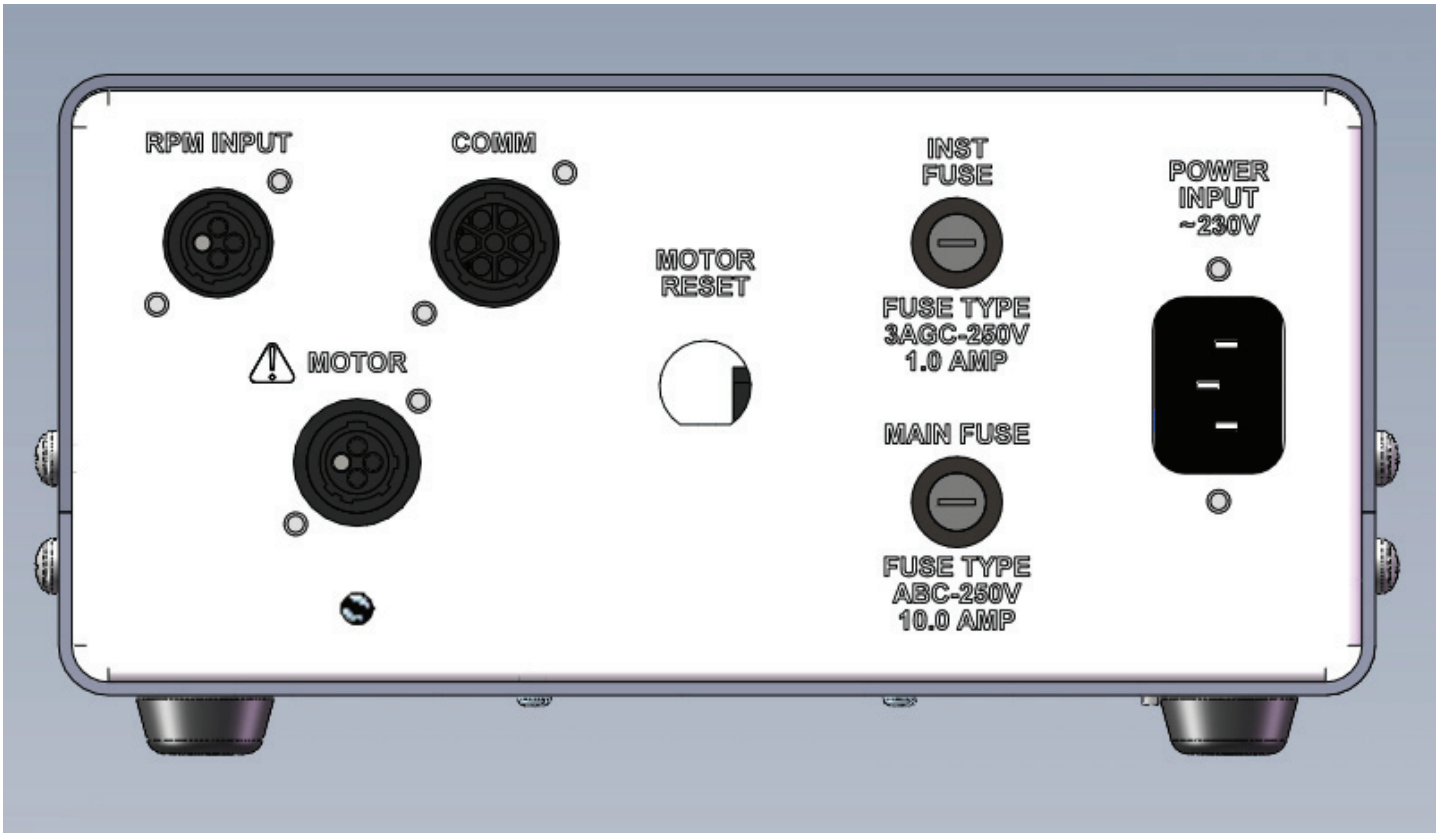
Motor:
Secure a clamp on motor cord to controller with provided screw next to motor socket for safety purposes.

The motor output connector is to be used only with Company motor assemblies supplied with the appropriate motor power cord.

Other appropriate connectors are provided on the rear panel of the controller.

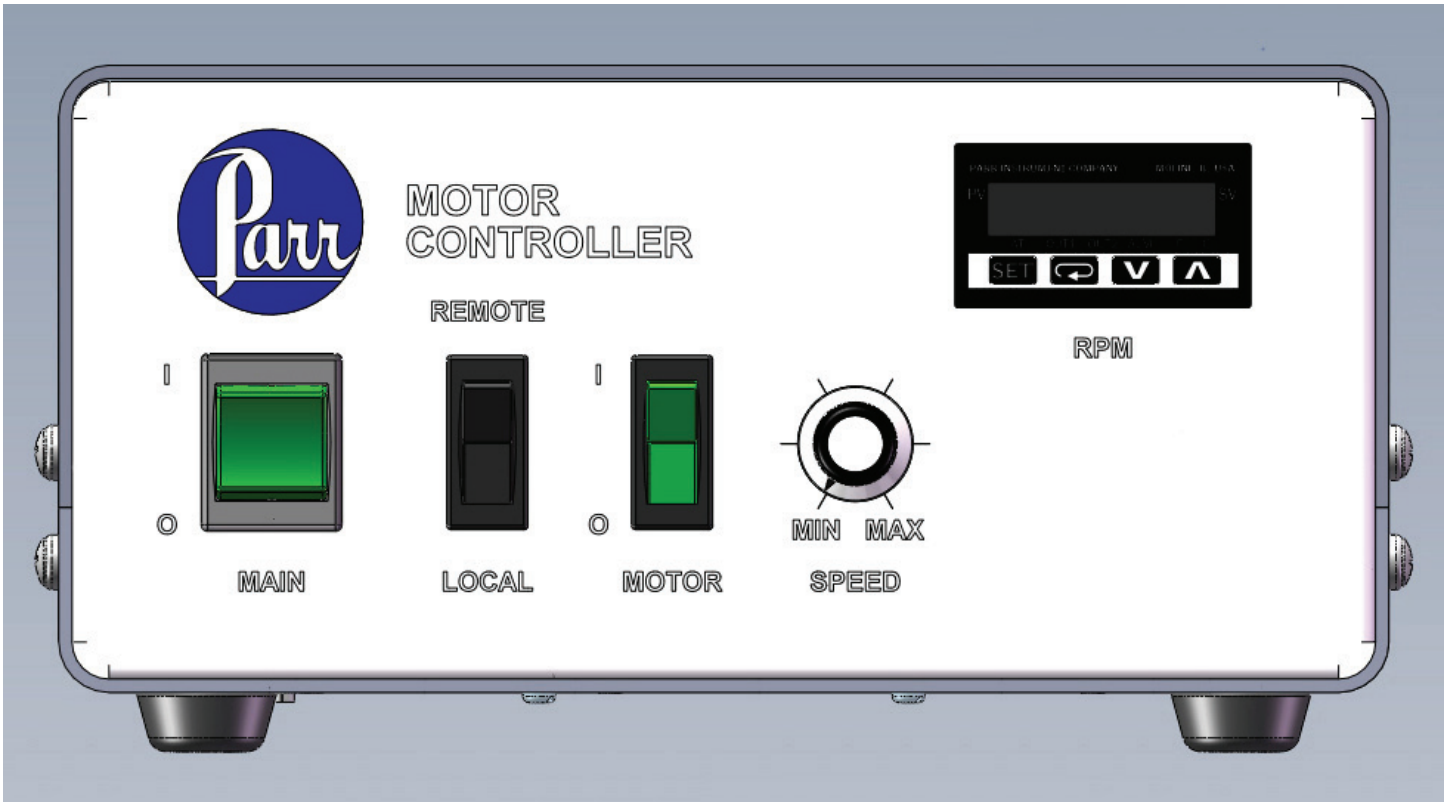
The **RPM Input** connection is for the RPM Module sensor input.

The **Comm** connector is for Communication output.



Rear View A2110E Motor Controller (230V shown)

Switches and Indicators



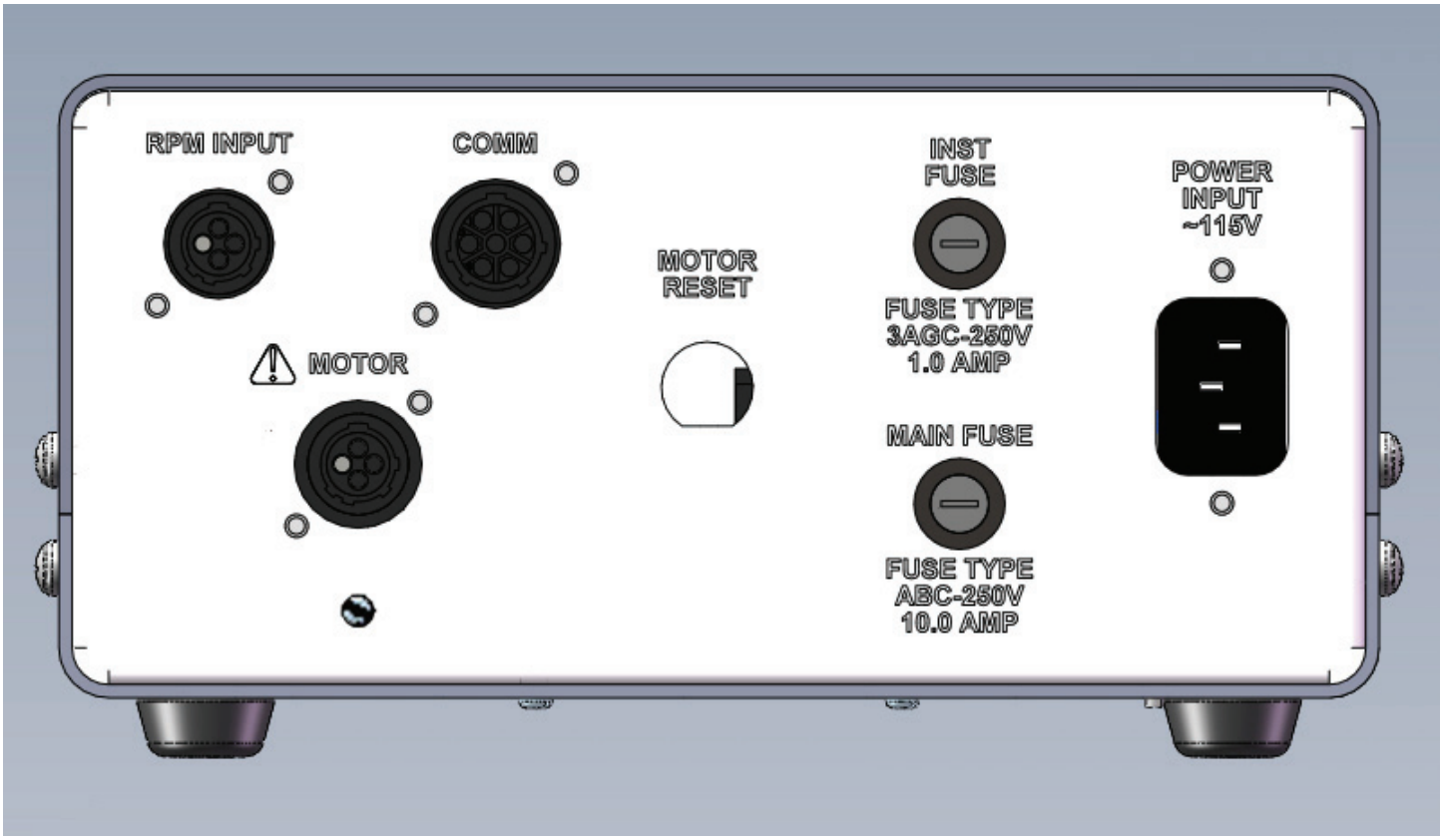
Front View A2110E Motor Controller

Main power switch

This switch will cut off power to the controller.

The Motor Controls consist of an **on-off switch** and a **speed control knob**. The speed control knob should be turned down to a minimum setting before turning on the motor switch to minimize electrical surges within the speed control unit.

The optional digital display shows the stirring speed from the sensor mounted on the reactor. If equipped with a motor control module, there will also be a **remote/local switch**. When the remote/local switch is in **local mode**, the speed control knob will adjust the motor stirring speed. When the remote/local switch is in remote mode, the motor stirring speed may be adjusted from the RPM module. If there is no motor control module installed, the remote/local port will be plugged and the speed control knob is the sole control for the stirring speed.



Rear View A2110E Motor Controller (115V shown)

Protective Fuses and Relays

An instrument fuse is mounted on the back panel. This is intended to protect the display module and internal hardware. A hole plug is provided for units that do not have a display module.

The **motor reset fuse** provides overload protection for 0-90VDC motors. This is a re-settable breaker designed to protect the motor if it becomes overloaded. The breaker will have a rating selected to match the motor on the apparatus.

A **lighted fuse holder** provides protection for 0-180 VDC motors. A light will come on if the motor becomes overloaded and the fuse burns out. The fuse rating will be selected to match the motor on the apparatus.

A **main fuse** is mounted on the back panel on 115V systems. This fast-acting, 250VAC, 10 amp fuse is intended to protect the controller and prevent an electric shock hazard from occurring.
Two **main fuses** are mounted on the back panel on 230V systems. These are fast-acting, 10 Amp, 250VAC and are intended to protect the controller and to prevent an electric shock hazard from occurring.

Caution!
Unplug unit before servicing. For continued protection against possible hazard, replace fuses with same type and rating of fuse.

Access to the Controller Cabinet

To open the controller cabinet, unplug the power cord and remove the four screws on the sides of the top panel. Then lift the top panel off, providing full access to all internal components.



Caution!
Inside of controller cabinet should be accessed by qualified personnel only.

Fuses

The A2110E Controller has a number of fuses which are intended to be field serviceable. The instrument fuse is only provided if there is a digital display meter installed.

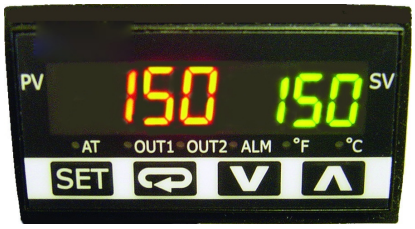
Fuse	Rating	Part number
Instrument Fuse	Fast acting, 1 Amp, 250VAC	139E6
Main Fuse(s)	Fast acting, 10 Amp, 250VAC	185E2
Motor fuse / reset	check back panel for specifications	check part list
Motor Board Fuse (A+)	Very Fast acting, 8 Amp, 250VAC	959E5
Motor Board Fuse (L)	Fast acting, 10 Amp, 250VAC	185E2



Caution!
Unplug unit before servicing. For continued protection against possible hazard, replace fuses with same type and rating of fuse.

Instructions for the A2110E Motor Controller

Motor Control Module (MCM)



RPM

This optional module can provide a means for continuously monitoring the stirring speed in a reactor. It consists of an optical sensor installed in the overarm drive on the reactor which is then connected to the A2110E Controller.

The connecting cable has a plug which fits the marked socket on the back panel of the controller. The digital display will show the stirring speed over a range of 0-2200 rpm with a 1 rpm resolution and +/- 10 rpm accuracy.

The left display in red shows the stirring speed, and the right hand display in green shows the rpm setpoint. The A2110E Controller is designed to run in either Local or Remote stirring mode. The local/remote switch on the front panel will toggle between these two modes.

In Local mode, the stirring speed is controlled by turning the speed control knob on the front panel. The rpm setpoint has no bearing on the stirring speed.

In Remote mode, the motor will stir at the rpm setpoint using closed loop PI control. The speed control knob has no bearing on the stirring speed. The RPM setpoint may be adjusted by following the steps below.

> ***Note:*** *The MCM leaves the factory in STOP mode. Before the MCM may be used in remote mode it must be set to RUN mode. Press the circular arrow key to display the RUN/STOP screen.*
>
> *For best results, use the RUN/STOP mode as the final switch. Return the MCM to STOP mode when the setpoint motor control is not desired, and return it to RUN mode as the last step to initiate the setpoint motor control.*

1. Ensure the local/remote switch is in the REMOTE position and the motor is motor switch is in the ON (I) position.
2. Ensure the MCM is in STOP mode. This can be done by momentarily pressing the return key (circular arrow) once, then using the up or down arrow to toggle between run and stop and pressing the SET key to solidify the change. Momentarily press the SET key to return to the operating display.
3. Press the UP arrow key until the red display indicates the desired setpoint. The display will blink indicating that the value has not been set.
4. Press the SET key to solidify the change and the display will stop blinking.
5. Return the controller to RUN mode by referencing step 1 above.

Motor Speed Control

A2110E Controllers are equipped with a solid state speed control module for use with the variable speed, DC motors installed on stirred reactors. The module itself (approximately 4 inches square) is mounted inside the chassis on the bottom panel. A motor switch and a speed adjustment potentiometer are mounted on the front panel. Each speed control module also requires a resistor matched to the horsepower of the motor with which it will be used, as listed in the table below:

Motor Rating	Motor Voltage	Resistor Required	Number
1/17 HP	90 VDC	0.25 ohm	876E6
1/8 HP	90 VDC	0.10 ohm	876E3
1/4 HP	90 VDC	0.05 ohm	876E
1/4 HP	180 VDC	0.10 ohm	876E3
1/2 HP	90 VDC	0.025 ohm	876E2
1/2 HP	180 VDC	0.05 ohm	876E
3/4 HP	180 VDC	0.035 ohm	876E5

A2110E Controllers furnished as a part of a complete stirred reactor system will have the proper resistor installed at the factory. Any controller sold separately will require a motor specification so that the proper resistor may be provided.

Always turn the speed control knob fully counterclockwise to the off position before turning on the motor switch, then advance the knob clockwise slowly to develop the desired speed. Do not overload the motor. Any high speed or high viscosity load which trips the circuit breaker is too heavy. Reduce the speed to avoid overloading and use the reset button on the rear panel to restart the motor.

Adjustments To Speed Control Board

There are five trimpots in the speed control module that can be used to adjust the performance of the motor. These are set at the factory for optimum performance and should not be disturbed unless customized settings are required to match a particular set of operating conditions. The instructions below should be followed carefully if these controls are to be readjusted.

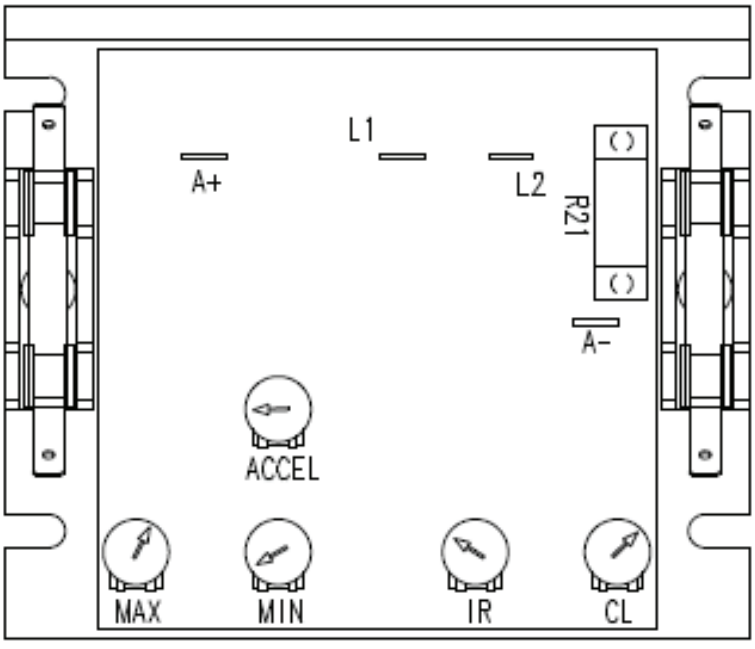
The CL, current limiting/torque adjustment is set at the factory to 1.5 times the motor rating. It is intended to protect both the module and the motor against overloads and heavy surge currents during startup. It can also serve as a torque limiting device by reducing the maximum power output of the system.

The IR, compensation adjustment is used to improve motor control under varying load conditions. If the loads do not fluctuate, this control can remain at approximately one-fourth of full setting. But if the motor speed drops more than 2% under load, this adjustment should be increased. If it is set too high, the motor speed will fluctuate in a cyclical manner.

The MAX, maximum speed adjustment controls the maximum speed of the motor. To increase the motor speed, turn the control knob on the front panel to its maximum setting, then use the MAX trimpot to raise the speed to the desired level. Care should be taken to ensure the setting will not allow the motor to turn faster than its maximum rated speed.

The MIN, minimum speed adjustment can be used to raise the minimum motor speed. To change this setting, turn the control knob on the front panel to its minimum setting, then adjust the MIN trimpot to obtain the desired minimum speed, this adjustment will also affect the maximum setting, making it necessary to adjust both MAX and MIN trimpots to obtain the desired spread.

The ACCEL, acceleration adjustment is normally set to provide controlled acceleration from zero to full speed in 2 seconds. It can be adjusted to higher or lower acceleration times anywhere between 0.5 and 4 seconds, but changing this setting will affect the MAX speed and IR compensation which will have to be readjusted. If the acceleration time is reduced to 0.5 seconds (6 o'clock trimpot position), increase the IR trimpot one quarter turn clockwise and decrease the MAX trimpot one fifth turn counterclockwise. If the acceleration time is increased to the maximum time of 4 seconds (full rotation), the IR trimpot must be decreased and the MAX increased in the same rotation amounts mentioned above.



Speed Control Board

Communication with PC

When a motor controller is present, the A2110E Controller is provided with RS-485 port to connect to a USB port on a PC with optional communication cable. With this arrangement, many parameters can be set and read by the host computer.

Quick Start Instructions for Connecting with PC

1. Put the 554M CD into the CD-ROM.

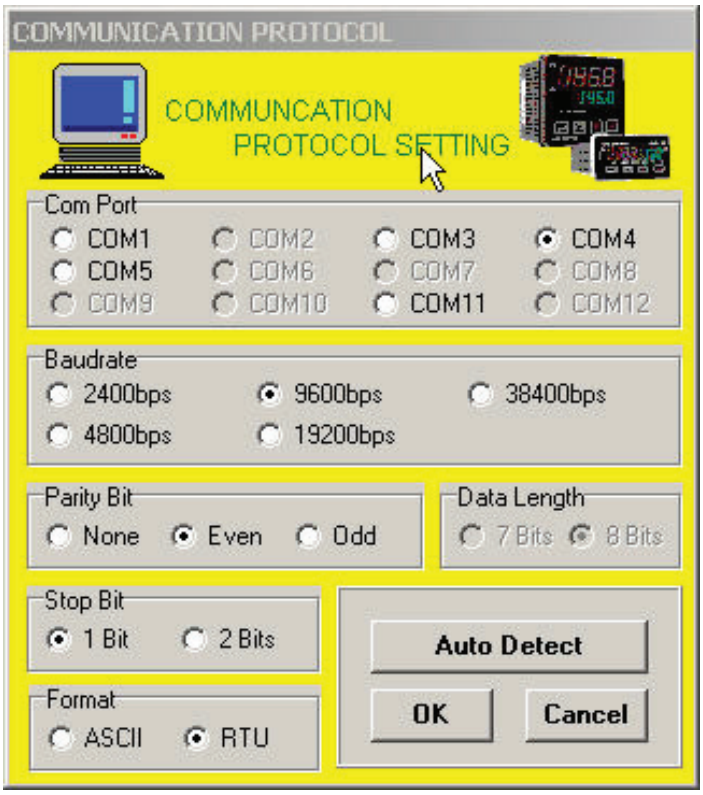
2. Connect the A1925E4 communication cable between the RS-485 port on the back of the A2110E controller and an open USB slot on the PC.
3. The PC should open an "Install Hardware" wizard automatically when the cable is connected to the USB slot. If it does not, go to the Control Panel and select "Add Hardware" to start the wizard.

4. When prompted, check the box to search removable media for the proper driver. The wizard should find the driver on the 554M CD and install the USB driver. It may prompt that the driver has not been validated; select "continue anyway" to continue the installation. After this it will repeat the installation process for the RS-485 converter.

5. Copy the controller software to the PC. The software is located on the CD at: "Software\ ___Com.exe".

6. Once copied to the PC, open the ___Com.exe file. No installation is necessary.

7. At the main ___Com program screen, select "protocol >> set PC". Ensure that the following values are set:
   Baud: 9600
   Data length: 8
   Parity: even
   Stop bit: 1
   ASCII: RTU



Click **OK** to return to the main screen.

8. At the main screen, select "Program >> Monitor". The Monitor screen will come up. There will be a generic icon on the left, and four mini screens on the right. Use one mini screen to connect to the A2110E Controller.

9. In the first mini screen, select 1 for the Address, and click Connect. It should connect to the digital display on the A2110E Controller, and the bottom half of the screen should show parameters for the controller. These may be modified here.

Datalogging and Charting

The A2110E Controller comes equipped with a charting and datalogging program. This program cannot be run simultaneously with the control program, but once the user is satisfied that the controller is set, the control program may be closed, allowing the charting and datalogging program to run. The module on the A2110E may still be modified manually at the physical panel during datalogging and charting.

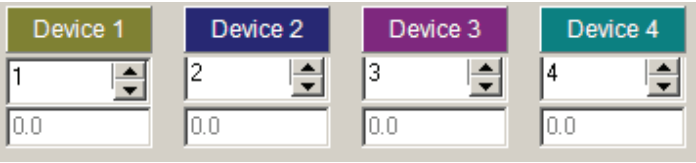
1. Open the ___Com.exe file. No installation is necessary.

2. At the main program screen, select "protocol >> set PC" (if you have already done previously, you may skip this step). Ensure that the following values are set:
   Baud: 9600
   Data length: 8
   Parity: even
   Stop bit: 1
   ASCII: RTU

Click **OK** to return to the main screen.

3. At the main screen, select "Program >> Recorder". The Recorder screen will come up.

4. Select the proper address for the digital display. The digital display has address 2.



5. Click the Save button and save a REC file to an appropriate place on the PC. When the chart is generated, it will write to this file.



6. When you return to the main Recorder screen, notice that the Save button is depressed. Hit the Start button to begin recording.



7. The chart will show the process values of each module represented. As the values change, the chart will automatically scale to show the values.

8. When you wish to stop recording, click the stop button. The chart has already been saved in the REC file created in step 5. You may view the chart by clicking the record button (shown on the left).



9. You can convert the file to a txt file for export to a spreadsheet as well.

Converting a Chart File to TXT

Once a chart REC file has been created, you can convert it to a TXT file for export into a spreadsheet.

1. Insert the 554M CD into the CD-ROM. Locate the conversion file at " \software\convert.exe". Copy it to the PC.

2. Open the convert.exe file. No installation is necessary.

3. Click the "CONVERT" button. Locate the REC file to be converted, and click "Open".

4. The conversion program will create a new TXT file in the same location as the REC file with the name "CONVFILE.TXT".

Parts List

Communication

Part number	Description
A1925E4	RS-485 to USB Conversion Cable

Fuses

Fuse	Rating	Part Number
Instrument Fuse	Fast acting, 1 Amp, 250VAC	139E6
Line Fuse(s)	Fast acting, 10 Amp, 250VAC	185E2
Motor Board Fuse (A+)	Very Fast acting, 8 Amp, 250VAC	959E5
Motor Board Fuse (L)	Fast acting, 10 Amp, 250VAC	185E2
Motor breaker / fuse		
1/2 hp, 180VDC	Slo-blo, 2.5 Amp, 250VAC	139E8
1/4 hp, 180VDC	Slo-blo, 1.5 Amp, 250VAC	139E19
3/4 hp, 180VDC	Slo-blo, 4.0 Amp, 250VAC	139E20
1/12 hp, 90VDC	Circuit breaker, 1.0 Amp	801E
1/17 hp, 90VDC	Circuit breaker, 1.0 Amp	801E
1/8 hp, 90VDC	Circuit breaker, 1.5 Amp	801E3
1/4 hp, 90VDC	Circuit breaker, 2.5 Amp	801E2
1/2 hp, 90VDC	Circuit breaker, 5.0 Amp	801E4



Caution!
For continued protection against possible hazard, replace fuses with same type and rating of fuse.

Speed Control Board

Part number	Description
A410E7EB	Speed control board, 1/17 hp, 115V
A410E7EE	Speed control board, 1/17 hp, 230V
A410E10EB	Speed control board, 1/8 hp, 115V
A410E10EE	Speed control board, 1/8 hp, 230V
A410E8EB	Speed control board, 1/4 hp, 90VDC, 115V
A410E8EE	Speed control board, 1/4 hp, 90VDC, 230V
A410E9EB	Speed control board, 1/2 hp, 90VDC, 115V
A410E9EE	Speed control board, 1/2 hp, 90VDC, 230V
A1252E2EE	Speed control board, 1/4 hp, 180VDC, 115V
A1252EEE	Speed control board, 1/2 hp, 180VDC, 230V
A1252E3EE	Speed control board, 3/4 hp, 180VDC, 230V
911E	Filter
2076E	Motor switch
2078	Local / Remote switch
2077E	Main switch
A1695E	Excitation / Conditioning board
2068E	Power supply, 24VDC
1588E	Signal Isolator for Remote Input

Tachometer Module (TDM) or Motor Control Module (MCM)

Part number	Description
A1001E	Optical sensor for cart reactor
A1001E2	Optical sensor for bench reactor
A1001E3	Optical sensor for gear box drives
A1001E4	Optical sensor for 4553/54/77/78
A1001E6	Optical sensor for 5100 reactor
A1001E8	Optical sensor for 3:1 gear box drive
A1001E9	Optical sensor for 4555 reactor
A1001E10	Optical sensor for 10:1 gear box drive
A1831E	Optical sensor for 5500 Compact Lab Reactor
1564HC	Slotted wheel for cart, bench, and low pressure (1:1) reactors
1564HC2	Slotted wheel for low pressure (2:1) reactors
3056HC	Slotted wheel for 5500 Compact Lab Reactor
A1177E8	Tachometer harness, 5-ft
A1177E	Tachometer harness, 10-ft
A1177E4	Tachometer harness, 15-ft
A1177E2	Tachometer harness, 20-ft
A1177E5	Tachometer harness, 25-ft
A1177E3	Tachometer harness, 30-ft
A1177E6	Tachometer harness, 35-ft
A1177E7	Tachometer harness, 40-ft
2084E	RPM meter