Instruction Manual

MODEL AC FLOW CONTROLLER

Electronics Inc.

Shot Peening Control

Electronics Inc.

56790 Magnetic Drive

Mishawaka, Indiana 46545

1-800-832-5653 (Toll Free)

Phone: **1-574-256-5001**

Fax: **1-574-256-5222**

E-mail: **sales@electronics-inc.com**

Website: www.electronics-inc.com

Made in the **USA**

Model AC Controller

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1. PRODUCT DESCRIPTION

The Model AC Amperage Controller is used with wheel-type shot peening and blast cleaning machines. It is designed to measure and control the rate of flow of steel shot passing through a special normally closed magnetic valve called a MagnaValve. A digital display is provided for indications of motor amps. A 0-10Vdc output signal is available for a remote indicator or a strip-chart recorder. High and low alarms are set to bracket the requested amperage setting. The alarm bandwidth is adjustable from the front panel. Either local (front panel) or remote 0-10Vdc *setpoint* commands may be used.

> **Caution:** The length of the motor amps current transformer wiring to the 50 mV current shunt at terminals #16 and #18 must be less than 10 feet (3 M) of 16AWG wire, otherwise the digital display reading will show lower than actual amps. Terminal #17 can be used to receive an input signal from motors with variable-speed drives equipped with a 0-5Vdc output. This signal is used for current/load monitoring. See section 14 for additional wiring information.

2. THEORY OF OPERATION

The AC Controller compares the motor current setpoint with the actual motor current sends a power signal to the MagnaValve. If the desired amperage is not achieved within an adjustable period, a high/low alarm relay will be triggered, outputting a signal that may be used to inhibit further machine operations and signal the operator.

3. PRELIMINARY ADJUSTMENTS

Refer to Figures 1 & 2..

a. Apply power to the AC controller.

b. The digital display (1-4) should read 0.0 when the motor is off.

c. Verify that the controller full-scale range matches the current transformer. Push and hold the display toggle switch (1-10) to the right and turn the setpoint knob (1-9) fully clockwise. The typical factory setting is 100.0A. To change this value, see section 6. **MOTOR CURRENT CALIBRATION (Span)**.

d. For automatic machine cycle, place the mode switch (1-11) to the left for the “Ready “mode. When an enable signal is received, the "ENABLE" LED indicator (1-2) on the front panel will light and activate the valve output. The red LED (1-3) for "valve" will blink. Adjust the motor amps setpoint to desired motor amperage level.

e. Adjust the alarm bandwidth (2-7), typically □5A. By pushing the display switch (1-10) to the left to exhibit the alarm bandwidth in the display, and turning the adjustment Pot to the desired setting.

f. Adjust the alarm delay time (2-6) from 0-10 seconds. Typically 5 seconds.

4. **OPERATION**

Operation consists of controlling motor current by modulating the shot flow rate through the MagnaValve and transmitting an alarm signal when motor current is above or below the desired flow range (amperage). The servo loop controls output voltage for the MagnaValve by comparing the setpoint command with the actual motor amps

a. **SETPOINT** (1-9) - To set the desired motor current, turn the setpoint knob and push display switch to the right to read desired amperage in the digital display. This will show the setpoint for either local or remote modes of operation. Release the display switch and the actual motor current will again be displayed. The setpoint may be adjusted during use. Pushing the display switch to the right is optional and not necessary while changing the setpoint during shot flow.

b. **ENABLE** (1-2) - The AC controller can be automatically activated by a remote enable signal when the mode switch (1-11) is in the “READY” position. The mode switch can be placed in the “off” position, to inhibit automatic operation or it can be placed in the “on” position for manual operation.

c. **ALARM** (1-5) - The alarm bandwidth is adjustable from 0 to 50% of full-scale and is factory set at 10%. The alarm circuit is activated when the servo is "on" and the control is enabled. When the control is enabled, the "ENABLE" LED (1-2), on the front panel, will be lighted. The midpoint of the alarm band automatically follows the setpoint setting. The servo switch (2-11) must be on (up) for the alarms to function.

d. **ALARM BAND** (2-7) - The flow setpoint is also the alarm midpoint. The alarm bandwidth, usually set at 5%, will track the setpoint . For example: a setpoint of 30A will have alarms set at 25 and 35A. Moving the setpoint to 45A will cause the alarms to move to 40 and 50A.

e. **ALARM DELAY** (2-6) - When the control is enabled and in servo mode, the "high" (1-5) or "low" (1-6) alarm light will come on if motor current is above or below the alarm limits. An adjustable timer, labeled "ALARM DELAY” (2-6) which is adjustable from 0 - 10 seconds, will start each time the "high" or "low" light comes on. If the fault lasts longer than the timer setting, the high (or low) light will get brighter and the high (or low) alarm relay contact will transfer and latch. The alarm will stay on after the “Enable” signal is removed until the alarm is reset.

f. **ALARM RESET** - Activating the alarm-reset circuit (115VAC applied to Terminal #14) will cancel the alarm relay and the alarm "high" or "low" LED's will go off. Continuous application of the reset signal will disable or inhibit the alarm output signal. The alarms are automatically reset upon receipt of each new "Enable" command and therefore using the manual alarm reset function is not necessary.

g. **REMOTE MODE** (1-6) - A remote setpoint command may be used in place of the front panel setpoint knob. To use this feature, the setpoint local/remote switch (2-12) must be down in the “REMOTE” mode. A yellow LED (1-8) on the front panel indicates operation in the remote mode. Apply a 0 - 10Vdc analog signal to the remote input, Terminal #10. A 0Vdc signal will correspond to 0% motor current command; and 10Vdc signal will correspond to 100% motor current. To verify the setpoint command, push and hold the display switch to the right. The remote command may come from a remote pot or any 0 – 10Vdc

signal source. An internal reference 10 Vdc excitation voltage for a remote potentiometer (10K OHM) is available at Terminal #4.

h. **MODE SWITCH** (1-11) - The mode switch is used to turn the control “on” or “off” or enable the remote “Ready” mode.

i. **RECORDER OUTPUT**- A recorder output analog voltage signal at terminal #20 with a 0 - 10 Vdc range is available to operate a strip-chart recorder or analog input card in data loggers. The minimum load on this output is 10K Ohms. Shielded cable should be used and the shield should be connected to AC® controller’s chassis ground. Additional noise filtering may be necessary at the input terminals of the analog input card to prevent erroneous readings from the recorder output.

5. **STABILITY ADJUSTMENTS - (SERVO STABILITY)**

The servo adjustments have been factory set to typical settings but the customer may fine-tune these settings to optimize the speed of response. Since many factors determine system stability, these adjustments should be made slowly.

SERVO GAIN - This adjustment sets the gain of the error amplifier over a range of 1% to 100%. Most systems may operate at 50%. If the motor current is unstable, then reduce the gain to 25%.

SERVO RESET - This adjustment determines the speed at which the output signal increases to achieve desired motor current. A 50% value is set at factory for typical applications. Turning the servo reset clockwise will make it faster and turning it counter clockwise will make it slower.

If the shot flow rate and motor current are not steady, it will be necessary to perform a simple stability test. Place the servo switch (2-11) in its off position. Enable the control and slowly increase the setpoint from 0% until the display reads the desired operating value. If the operation at this time is unstable, then it is the system that is unstable. Since the control is in manual mode, if motor current is unstable, then the machine itself is causing a problem, not the servo adjustments (because the servo is off). Refer to the Trouble-Shooting Section 12.

6. **MOTOR CURRENT CALIBRATION (Span)**

Caution: The factory has preset the span adjustment so that 5 A AC input will result in a full-scale display reading. To accommodate different ranges of current transformers, such as 100:5 or 50:5, change the Display Full-Scale Adjustments, not the span setting. See section 7.
DO NOT ADJUST THE AC® CONTROLLER SPAN, IT HAS BEEN FACTORY SET AND SEALED.

7. **MOTOR CURRENT FULL SCALE DISPLAY**

The standard factory setting is for 100:5 current transformers. To use other current transformer ratios proceed as follows:

a. Apply power to AC controller.

b. Set the servo switch (2-11) to the off (down) position.

c. Turn the motor off.

d. Turn the “setpoint” knob on the front panel full clockwise. Push and hold the “display switch” to right. Adjust "display range coarse/fine" trimpots (2-8) and (2-9) to set the display to equal the current transformer amp rating (not motor full load amps).

e. Rotate the setpoint knob fully counterclockwise. Start the motor.

f. Start the valve (apply Enable signal-or use on/off/ready mode switch (1-11) on front).

g. Slowly turn setpoint knob clockwise until desired motor current is achieved.

h. **NOTE**: The factory calibration of the input span should not need any adjustment. Verify that the wire size is adequate in the 5-amp loop of the current transformer secondary. It should be a minimum of 16 AWG for short runs of 5 feet or less. Longer runs should use 14 AWG or 12 AWG. If the digital amps display is compared to a clamp-on type ammeter and is accurate at the low amps but not at higher operating amps, then the 5-amp loop wire is too small. Use a larger gage wire or re-locate the current shunt from the rear terminal strip closer to the current transformer and connect the shunt to the AC controller using 18 AWG or larger shield cable.

i. If the digital amps display reading is unstable, then a system problem exists. Do not make any servo adjustments (the servo is off) until the cause of unstable operation in manual mode is corrected. See Trouble-Shooting Section XIII.

j. Turn Enable off.

k. Place servo switch (2-11) on.

l. Push display switch to right and adjust setpoint to typical motor amps.

m. Enable the control and note the motor amps response time and stability. If the response time is too fast (unstable) or too slow (sluggish), refer to Section 5 for stability adjustment.

8. SPARE PARTS LIST

There are no spare parts recommended for the AC controller. Contact the factory for assistance.

9. WARRANTY

Electronics Incorporated warrants this product to be free from defect in material and workmanship for a period of two years from date of original shipment. Defective units must be returned to Electronics Incorporated with shipping costs prepaid. Electronics Incorporated will repair or replace defective unit at its option. No consequential liability is assumed. No other warranty, including merchantability or fitness for purpose, applies or is expressed or implied.

Warranty work is only available at the factory. On-site service or start-up assistance is available at extra cost to customer.

Caution: Any customer attempts to modify or repair the product during the warranty period will terminate the warranty. Standard technician labor rates will be quoted prior to repair.

10. UPGRADES - REVISIONS

Design improvements are constantly being made to our products. Please contact Electronics Incorporated for details. When ordering spare units, please refer to model number and serial number of each unit.

11. AUTO-ZERO FEATURE

An auto-zero feature is available to maintain a true zero reading during the motor-off condition. This circuit monitors the motor current signal and forces it to zero whenever the motor is off and the Enable signal is absent. A blue LED on the front panel indicates the auto-zero is active. When the valve Enable signal is present the auto-zero function is disabled.

12. TROUBLESHOOTING GUIDE

1. Unstable operation

a. Several conditions can affect motor current stability. It is important to determine if the problem is caused by the machine or by the MagnaValve.
   i. Place the servo switch (2 - 11) to the off (down) position.
   ii. Turn the machine on and apply the Enable signal to Terminal #3 or place mode switch to on (right) position.
   iii. Slowly turn the setpoint control (1-9) clockwise to increase the motor amps until either the panel display reading is at desired value or the motor amps display is at the desired value. The motor amps feedback signal does not affect the controller stability in this mode (servo off). Therefore, the wheel is the only cause for instability.

b. To demonstrate this further, another test can be performed.
   i. 1. Close the slide gate above the MagnaValve.
   ii. 2. Start the wheel and apply the Enable signal.
   iii. 3. Turn the setpoint control (1-9) to 100% or full clockwise position. The red LED valve light will be constantly on and the MagnaValve will be in its maximum flow condition. Slowly open the slide gate and observe the wheel ammeter for stability.
   iv. 4. If the motor current is unstable, the problem is due to the machine, not the Amperage Controller or MagnaValve.

c. If the machine uses a variable speed drive, check it for stability or bypass it with a conventional motor starter. The instability may be caused by flooding/choking the wheel or demanding more shot than the wheel can supply.
   i. Check for obstructions or restrictions or unnecessary bends in the flow path.
   ii. Worn blades or damaged control cages will not pass as much shot as new blades, therefore, as blades wear, the maximum motor amperage is reduced.
   iii. Shot condition is very important. Unclean shot due to oil, water or dust, can cause erratic flow performance. Dust can be generated by shot deterioration, or by abrasion of parts being peened, the cabinet, or the tooling. Dust will tend to cake and clog the flow. Under severe conditions, the MagnaValve may become completely

blocked.

2. **Setpoint does not control motor current**

   a. Green LED (1 - 7) “Local” should be on for local setpoint knob operation.
   b. Enable signal must be present (Terminal #3). The “Enable” LED must be lighted (1-2).
   c. MagnaValves operate using a magnetic field and have no moving parts. Large air suction in some wheel designs may pull shot through the valve. This symptom is characterized by having shot flowing when valve is off (red valve LED=off). Providing an aspiration air inlet below the MagnaValve may be necessary. Contact factory for assistance.
   d. MagnaValve valve driver module may be defective. The output current setting is listed on the valve driver module. Check the valve current at 100% duty cycle (Red LED constantly on) with an ammeter in series, with wire lead from the controller to the valve driver module. Contact factory for assistance.

3. **No alarm relay contact output.**

   a. Enable must be on (1 - 2).
   b. Servo switch must be on (2 - 11).
   c. High (1-5) or low (1 - 6) Alarm LED must be on and in the bright mode for alarm relay contact to transfer.
   d. Check alarm bandwidth; it may be too large.
   e. Check wiring from the terminals:
      i. High Alarm Relay Contact = #11
      ii. Common Alarm Relay Contact = #12
      iii. Low Alarm Relay Contact = #13
   f. Alarm Reset signal (120VAC) should be absent from terminal #14. (**NOTE**: Alarms are cleared or reset each time a new Enable signal is received; therefore, using the manual alarm reset feature is not necessary.)

4. **Cannot achieve any flow, or motor amps are very low.**

   a. Enable light must be on (1 - 2).
   b. Setpoint command must be present (check setpoint using toggle switch to right).
   c. Red LED "Valve" should be bright and blinking or constantly on. An internal circuit breaker has tripped if it is dim. Check for short-circuit valve wiring at Terminals #7 and #8. To reset the circuit breaker, remove and reapply the Enable signal.
   d. Check Red LED at MagnaValve junction box. If it is not off, check for a wiring problem. If it is on, verify that the current going to the valve driver module matches the value written on the label of the valve driver module.
   e. Check for contamination in or above the MagnaValve, especially check for water, oil, or dust mixture in the shot, or other obstructions.
   f. The MagnaValve or valve driver module may be defective. To check, remove the MagnaValve from machine (keep wires attached). Enable the output and get red LED valve on at 100% duty cycle. When the Valve LED is on, the magnetic field inside the MagnaValve should be perfectly canceled. No shot should stick inside the MagnaValve. If any shot sticks to the valve, then either the valve driver module or the MagnaValve is defective. Measure the dc current going to the valve driver module in the red wire. Compare your measurement with the value written on the label of the valve driver module. If your

reading is not within 10%, then the valve driver is defective or not adjusted properly. Be sure the replacement valve driver is pre-calibrated to the same value as the original module. If the reading is within 10% of the original valve driver calibration, the valve driver module is okay but the valve is defective.

5. **Motor amps are erratic or unstable.**

a. New installations - refer to servo adjustments.
b. Old installations - machine worked fine until recently.
    i. Check shot for cleanliness (dust, oil, and water).
    ii. Check shot for obstructions.
    iii. Check shot hopper, is it low or out of shot?
    iv. Do not adjust servo adjustments.
    v. Check for worn wheel blades or worn control cage.
    vi. Check valve driver module and MagnaValve® current.
    vii. Call the factory for advice.

NOTE: This category is the most challenging to trouble shoot. We have found that shot cleanliness and foreign objects are usually responsible. Items such as: wire (from identification tags), welding rod, nuts and bolts from machine or screen separators, masking tape, razor blades, milk cartons, cigarette butts, etc., seem to find their way to the valve.

6. **Calibration Accuracy at low and high amps**

If the amperage on the digital display matches the actual motor current at a low setting but not at a higher setting, compare the motor amps with a clamp-on type ammeter to the current transformer output. If it is not proportional then the wire size for the current loop is too small and must be increased. Up to 5-foot long wire loops can use 16 AWG wire. Longer runs should use 14 AWG or 12 AWG wire.

7. **Technical Support**

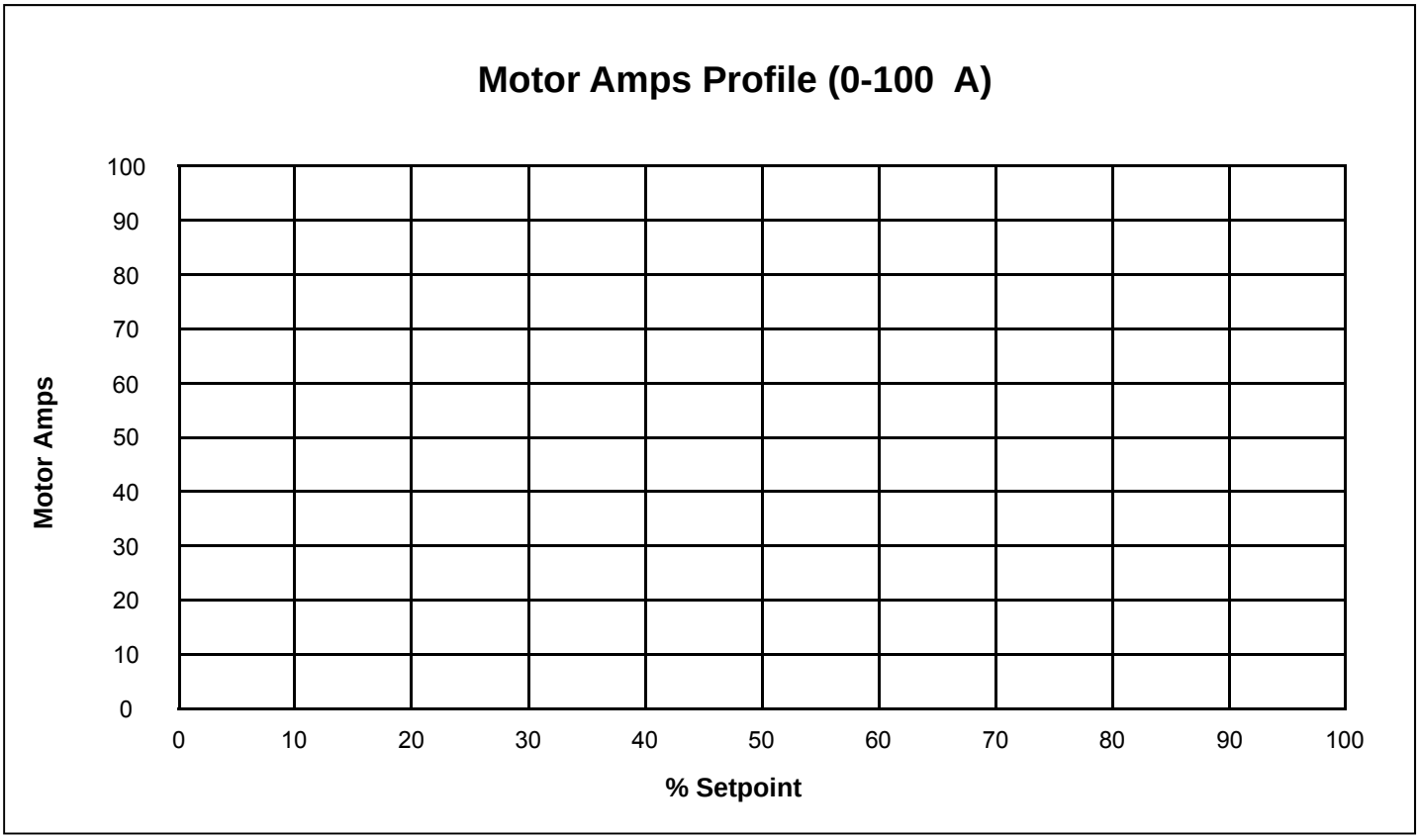
If you cannot achieve expected high motor amperage or the system “just isn’t right”, then perform the following profile before calling for technical support. This procedure will provide the information needed for corrective action.

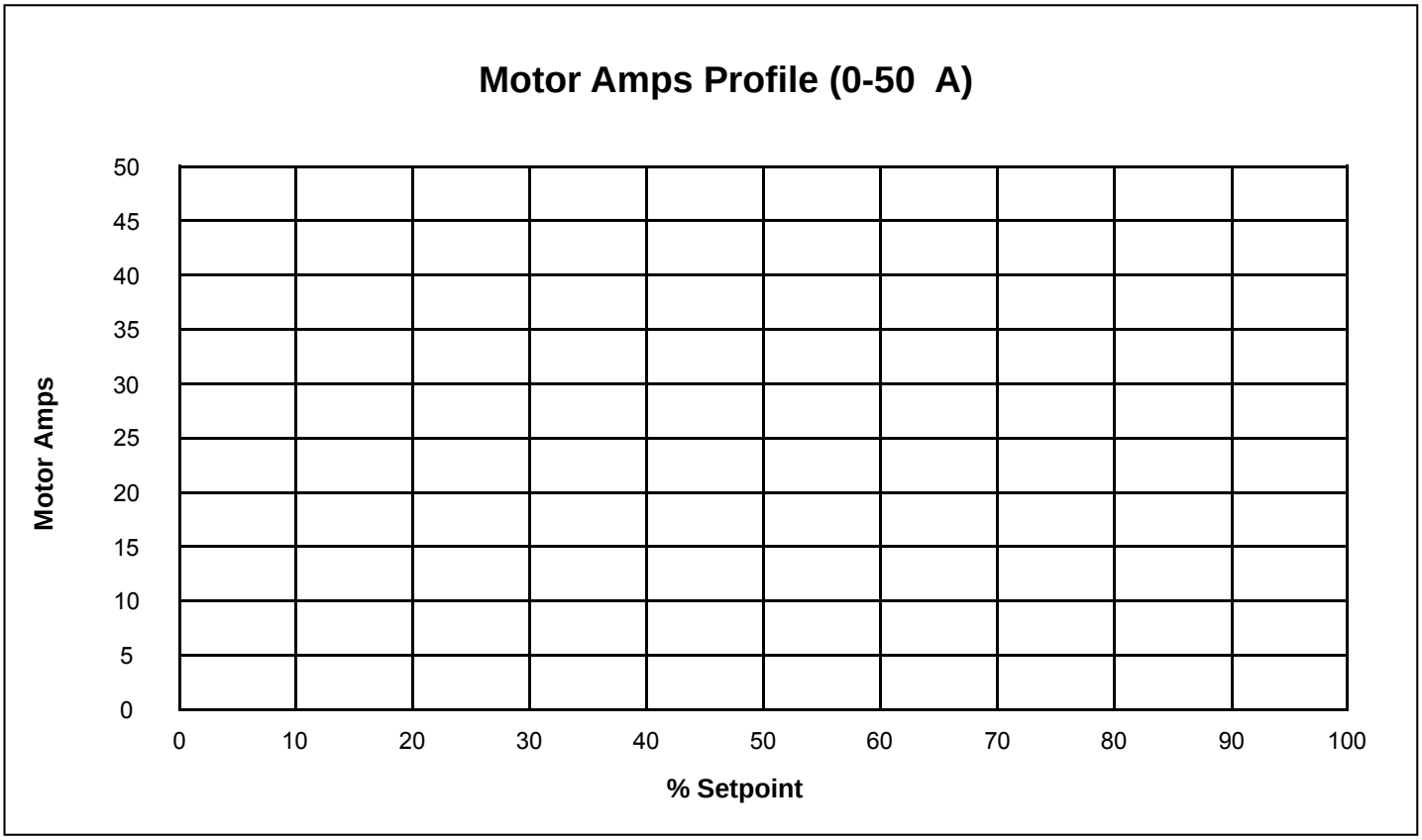
    i. Place the Servo switch “off” in the manual mode.
    ii. Use the Display Toggle switch to set the setpoints in the following table.
    iii. Read and record the amperage reading for each of the above setpoints.

iv. FAX this information to Electronics Incorporated for assistance. (1-574-256-5222)

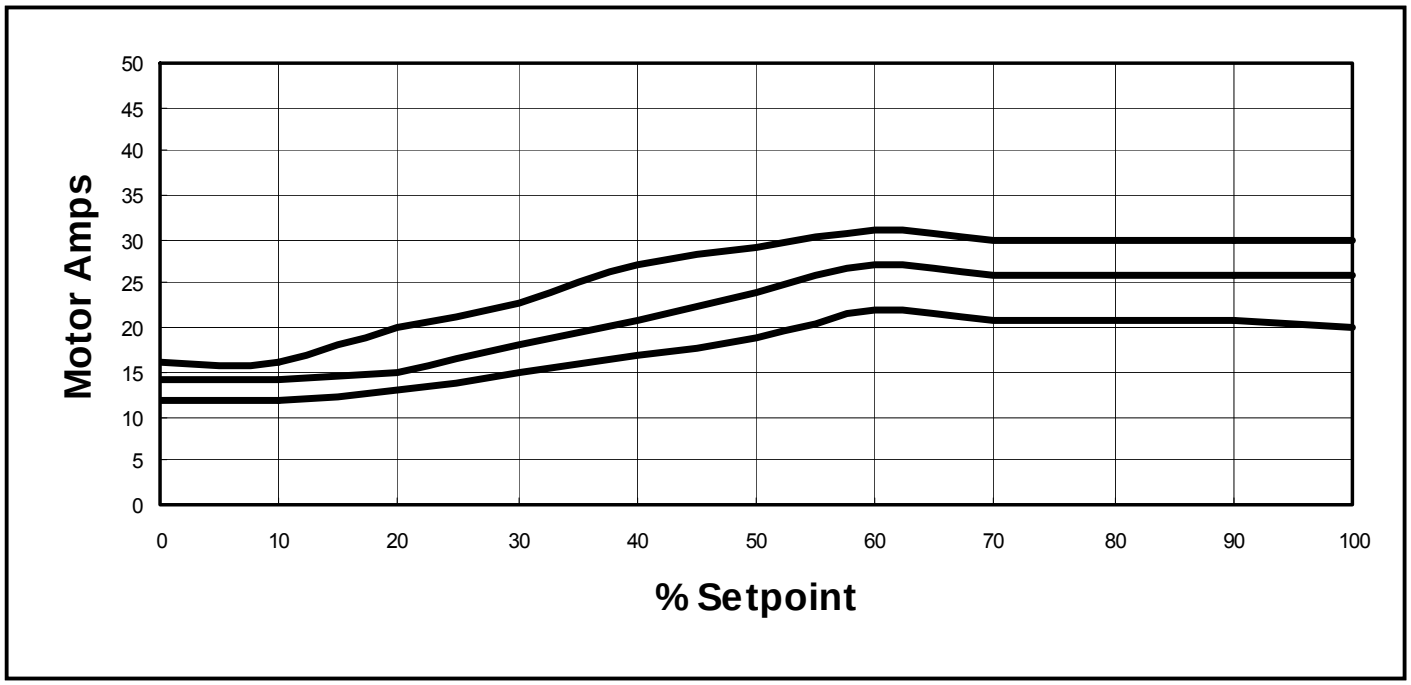
This test is performed with the “SERVO” switch turned OFF. Plot the data on the following tables and

	Motor Information FL Amps=_____ H.P.=_____ RPM=_____	Company Name: _____ Technicians Name: _____ Call back Phone _____ Date: _____Notes:
Setpoint Knob	Motor Amps	Comments:
0%		
10%		
20%		
30%		
40%		
50%		
60%		
70%		
80%		
90%		
100%		

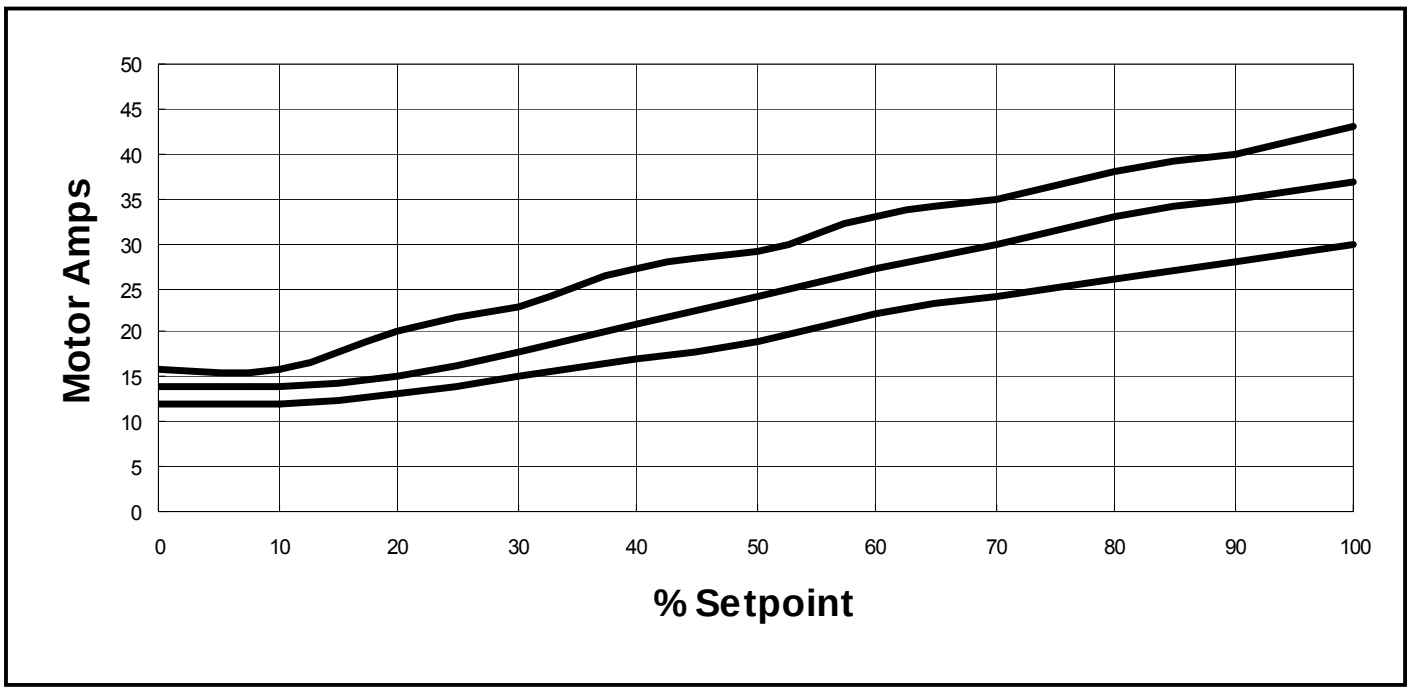



Motor Amps Profile (0-50 A)
Motor Amps
50
45
40
35
30
25
20
15
10
5
0
0
10
20
30
40
50
60
70
80
90
100
% Setpoint

The following graphs show the results from two types of shot flow rate conditions. The first shows a condition where the maximum amperage is too low due to restricted maximum shot flow rate. This can be caused by inadequate sizing of the openings in the shot hopper or contamination (blockage) either above or below the MagnaValve. This could also be caused by restrictions at the wheel inlet due to pipe size or the wheel not being sized properly to discharge enough media at a given motor RMP.



The second example shows a typical installation where the full load (FL) motor current of 35 A is achieved at approximately 70% of MagnaValve capacity with the wheel running at 3000 RPM. This indicates that the valve is able to supply all the shot needed and has a reserve capacity of 30%. **Caution**: Do not allow operation above the full load rating of the motor.



13. CALCULATING FLOW RATE IN POUNDS/MINUTE

To determine the pounds per minute flow rate perform a catch and weigh test. A large container in which to catch the shot for at least 15 seconds of flow will be needed. Since the AC controller is a current controller and not a flow rate controller, some extra steps to determine the effective shot flow rate will be required.

a. Select an amperage setting that is typical of the operation. Place the servo switch in the off (down) position. Place the setpoint knob at its minimum setting. Start the wheel and slowly increase the output using the setpoint knob until the desired amperage is achieved.
b. Stop the wheel and remove the feed hose from the wheel feed spout and aim it at the catch bucket.
c. **Caution**: Do not start the wheel.
d. Enable the controller, flow shot for 15 seconds and catch it in the bucket.
e. Weigh the shot, subtract the (empty) bucket weight, and multiply by 4 to get pounds/minute.
f. Repeat the test to assure accuracy.
g. Reassemble the hose to the feed spout and return the servo switch to the ON position (up).

NOTE: The above procedure only works because the servo is turned off. In this mode the setpoint knob sets the output manually and ignores the motor amperage feedback signal, which during the catch and weigh test is zero. The procedure works because the flow rate is established manually with the wheel motor current. In order to select another flow rate it will be necessary to have the feed spout in place and manually set the output to a new condition.

FIGURE 1. FRONT PANEL DESCRIPTION - (Operator Controls)

1. **AUTO-ZERO** - This LED indicator is on when the auto-zero function is forcing the display to zero. The “enable” and the wheel motor must be off for this function to operate. The Auto-zero may be disabled, (2-2)

2. **ENABLE** - This LED indicator will be on if the mode switch is "on" or if mode switch is in "ready" mode and costumer applies 120VAC to Terminal #3 (control enable).

3. **VALVE -** This LED indicator shows power output to the MagnaValve at fixed 8-Hertz rate and variable duty cycle.

4. **DIGITAL DISPLAY -** Indicates the motor amps. Pushing the *display switch* (1-11) to the right displays the amperage setpoint. Pushing *display switch* to the left will display the alarm bandwidth (in amps).

5. **HIGH ALARM -** This LED indicator will be on when the control is enabled and the motor amps exceed the high alarm trip point [setpoint + alarm band]. When the Alarm Time “Times Out” the LED will get brighter and the High Alarm Relay Contact will close.

6. **LOW ALARM -** This LED indicator will be on when the control is enabled and the motor amps are less than the low alarm trip point [setpoint-alarm band]. When the Alarm Time Relay “Times Out” the LED will et brighter and the Low Alarm Relay Contact will close

7. **LOCAL -** This LED indicator shows that the control is in the “local” mode and the setpoint knob below it will command the motor amps. When this indicator is “on” the remote mode indicator is “off”.

8. **REMOTE - This** LED indicator shows that the control is in the “remote” mode and a remote analog 0-10 Vdc command is expected at terminal #10. The “*setpoint”* knob is not active when the remote LED is on.

9. **SETPOINT KNOB -** This knob will set the desired motor amps and the midpoint of the alarm *bandwidth* when the control is in local mode *(local* LED indicator must be on). Push the *display switch* to the right to see amperage *setpoint* in the digital display.

10. **DISPLAY SWITCH -** Push to the left to read the alarm bandwidth. Push to the right to read *setpoint* command. When the switch is in the center position, the actual motor amps are displayed.

11. **MODE SWITCH -** This switch determines the controller mode of operation.
    a. Right = Forced on
    b. Middle = Forced off
    c. Left = Ready (waiting for 120VAC "Enable" signal from machine at terminal #3)

12. **DECAL -** Model Number and revision level is shown on this decal. Space is provided for customer annotation.

13. **CALIBRATION DECAL -** Customer may place a calibration decal here to restrict access to the internal adjustments normally made by technicians only.

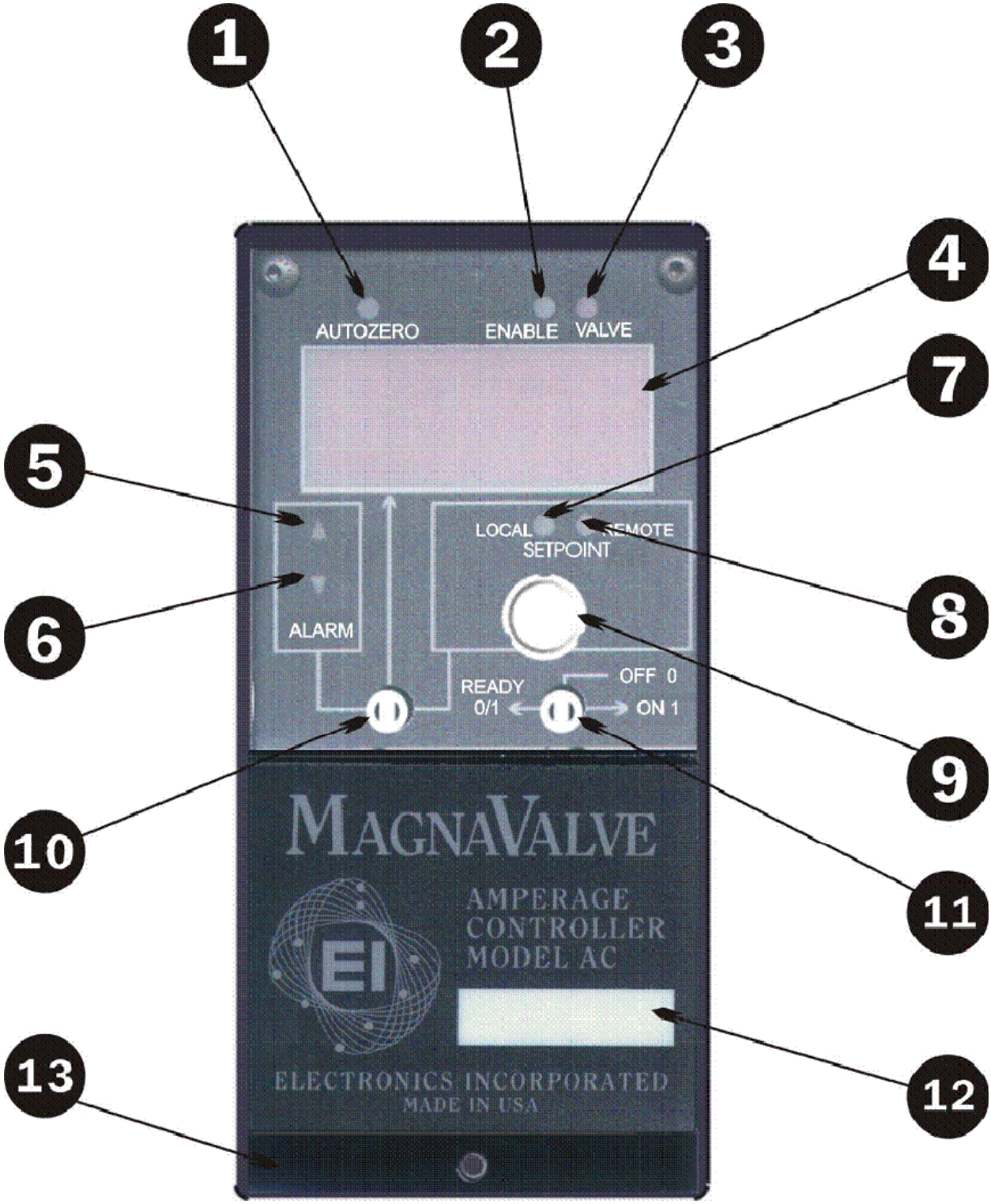


FIGURE 1. FRONT PANEL - Operator Controls

FIGURE 2. FRONT PANEL DESCRIPTION - (Technical Adjustments)

1. **SPAN ADJUST** - Please do not adjust the Span. This is a factory setting. Do not remove the calibration sticker.

2. **ZERO ADJUST** - Please do not adjust the Zero. This is a factory setting. Do not remove the calibration sticker.

3. **AUTO-ZERO SWITCH** - Used to activate or deactivate the auto-zero function. Auto-zero forces the digital display to zero whenever the enable signal and the motor are off. The Auto-zero blue LED indicator will show that it is active.

4. **SERVO GAIN** - Used to adjust the gain of the error amplifier in the servo. High gain requires less error to cause servo correction. Turn clockwise for more gain. If the gain is too high, the servo may be unstable.

5. **SERVO RESET** - Used to adjust the speed of the servo response. Faster reset allows faster response to an error condition. Turn clockwise for faster reset. If the reset is too fast, the servo may be unstable.

6. **ALARM DELAY TIME** - Used to set the time allowed before the alarm relay contact will operate. The high or low alarm LED's will go to a bright condition when this timer expires. The range is 0-10 seconds.

7. **ALARM BANDWIDTH** - Used to set the □ amps width of the alarm zone. The Alarm Bandwidth is adjustable from 0% to 50%. The alarm midpoint follows the command Setpoint. Push the display switch left to display alarm bandwidth.

8. **DISPLAY RANGE FINE** - Used to adjust the digital display range to the full scale (current transformer) range desired.

9. **DISPLAY RANGE COARSE** - Used to select the digital display range to the full-scale range (current transformer) desired.

10. **DIGITAL DISPLAY DECIMAL POINT** - Used to select the decimal point position on the digital display. Choices are: 1000 / 100.0 / 10.00.

11. **SERVO SWITCH** - Used to control the servo. Up is "on" for automatic servo control. Down is "off" for manual operation. The alarms do not function and no motor amps servo correction is provided when the servo is off.

12. **SETPOINT LOCAL / REMOTE** - Used to select the Setpoint command from the front panel knob or from an external remote analog 0-10 Vdc command.

13. **FREQUENCY ADJUST** - Factory set at 8 Hertz. Adjusts the frequency of the pulse output signal to the MagnaValve. The new 1xxx series MagnaValves can be set to 15-25 Hertz.

14. **ENABLE DELAY** – Used to adjust the time delay (0-10sec.) from receipt of enable Signal until valve output. Useful in direct pressure blasting machines to allow air pressure to stabilize prior to starting the valve. For suction blast or wheel-blast machines this should be set to zero.

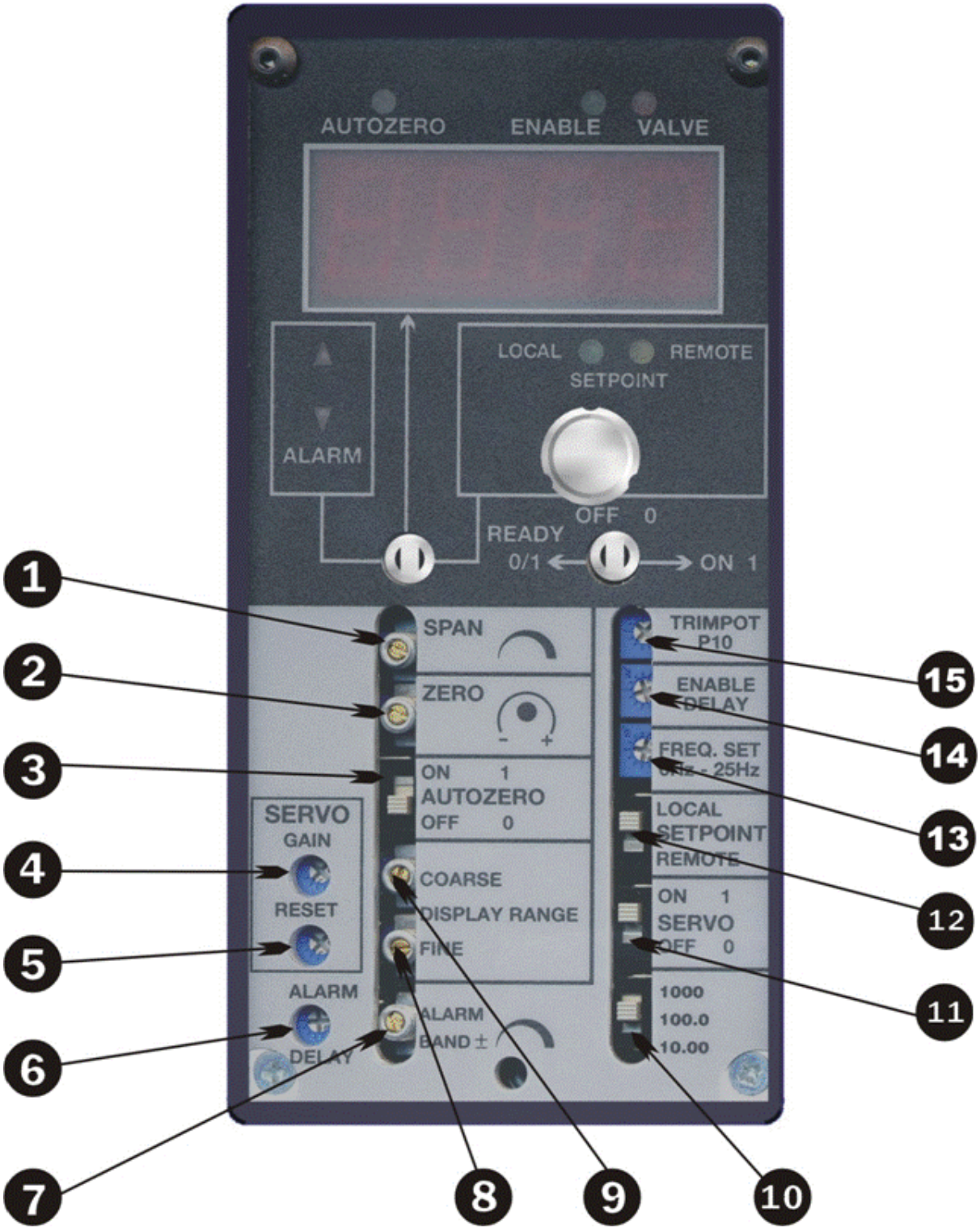


FIGURE 2. FRONT PANEL - Technician Adjustments

14. **WIRING CONNECTIONS FOR P/N 999201**

1.	Power Neutral (120VAC)
2.	Power Hot (120VAC, 50/60 Hz, 25VA)
3.	Input Enable (120VAC)
4.	(+) 10 Vdc Reference Output for external remote *setpoint* command excitation
5.	(+) 12 Vdc Excitation Output for MagnaValve preamp (not used with VLP MagnaValve)
6.	(-) 12 Vdc Excitation Output for MagnaValve preamp (not used with VLP MagnaValve)
7.	(+) MagnaValve Output (in conduit or SO cord, does not have to be shielded)
8.	(-) MagnaValve Output (in conduit or SO cord, does not have to be shielded)
9.	Common Remote Setpoint (0Vdc)
10.	Input Remote Setpoint (0-10 Vdc) (shielded cable)
11.	High Alarm Relay Contact
12.	Common Alarm Relay Contact
13.	Low Alarm Relay Contact
14.	Alarm Reset Input (120VAC)
15.	(Not used)
16.	Input Current Shunt (0-5A ac) E.I. current shunt P/N 999200
17.	Input Voltage (0-5 Vdc) (shielded cable)
18.	Common Current Shunt or Voltage (0Vdc)
19.	Common Recorder Signal (0Vdc)
20.	Output Recorder Signal (0-10 Vdc) (shielded cable)

NOTE: Connect 100:5 current transformer leads to current shunt at terminals #16 and #18. Use 16AWG wire and keep it shorter than 10 feet to avoid losing signal strength. If the current transformer is further away than 10 feet it may be necessary to use larger wire size or mount the current shunt next to the current transformer and then connect the shunt to the AC controller using #18AWG shielded cable.

Motor speed controllers with 0-5 Vdc output load monitor may be connected to terminals #17 and #18 using shielded cable.

A small, 10µF, capacitor may be needed at the far end of the cable for recorder output to suppress electrical noise signals. The near end of the shield (screen) should be connected to the rear of the AC chassis green screw terminal.

15. **SPECIFICATIONS (P/N 999201)**

Power:	(90-120VAC @ 60Hz) (110-120VAC @ 50Hz), 25VA
Inputs:	Current Shunt Input (0-5A). Electronics Inc. P/N 999200 (included)
	Voltage Signal Input (0-5 Vdc)
	Remote Command Setpoint Input (0-10 Vdc)
	Enable (90-120VAC @ 60Hz) (110-120VAC @ 50Hz)
	Alarm Reset (90-120VAC @ 60Hz) (110-120VAC @ 50Hz)
Outputs:	Valve Power: 60 Vdc PWM at 8 Hertz
	Alarm Relay Contacts: 120VAC @ 1A
	Excitation Voltage: +/-12Vdc @ 100mA
	Reference Voltage: +10Vdc @ 10mA
Weight:	4 Lbs. (1.8 kg)
Display Range:	0 - 1999 counts
Decimal Places:	1000 / 100.0 / 10.00
Alarm Band:	0 - 50% of full scale
Alarm Delay:	0 - 10 Seconds

16. **WIRING CONNECTIONS FOR P/N 999201.B**

1.	Power Neutral (90-240VAC)
2.	Power Hot (90-240VAC, 50/60 Hz, 50VA)
3.	Input Enable (80-240VAC)
4.	(+) 10 Vdc Reference Output for external remote *setpoint* command excitation
5.	(+) 12 Vdc Excitation Output for MagnaValve preamp (not used with VLP MagnaValve)
6.	(-) 12 Vdc Excitation Output for MagnaValve preamp (not used with VLP MagnaValve)
7.	(+) MagnaValve Output (in conduit or SO cord, does not have to be shielded)
8.	(-) MagnaValve Output (in conduit or SO cord, does not have to be shielded)
9.	Common Remote Setpoint (0Vdc)
10.	Input Remote Setpoint (0-10Vdc) (shielded cable)
11.	High Alarm Relay Contact
12.	Common Alarm Relay Contact
13.	Low Alarm Relay Contact
14.	Alarm Reset Input (80-240VAC)
15.	(Not used)
16.	Input Current Shunt (0-5A ac) E.I. current shunt P/N 999200
17.	Input Voltage (0-5Vdc) (shielded cable)
18.	Common Current Shunt or Voltage (0Vdc)
19.	Common Recorder Signal (0Vdc)
20.	Output Recorder Signal (0-10Vdc) (shielded cable)

NOTE: Connect 100:5 current transformer leads to current shunt at terminals #16 and #18. Use 16AWG wire and keep it shorter than 10 feet to avoid losing signal strength. If the current transformer is further away than 10 feet it may be necessary to use larger wire size or mount the current shunt next to the current transformer and then connect the shunt to the AC controller using #18AWG shielded cable.

Motor speed controllers with 0-5 Vdc output load monitor may be connected to terminals #17 and #18 using shielded cable.

A small, 10µF, capacitor may be needed at the far end of the cable for recorder output to suppress electrical noise signals. The near end of the shield (screen) should be connected to the rear of the AC chassis green screw terminal.

17. **SPECIFICATIONS (P/N 999201.B)**

Power:	90-240VAC, 50/60 Hertz, 50VA No internal fuse (1A recommended)
Inputs:	Current Shunt Input (0-5A). Electronics Inc. P/N 999200 (included)
	Voltage Signal Input (0-5Vdc)
	Remote Command Setpoint Input (0 -10Vdc)
	Enable (80-240VAC)
	Alarm Reset (80-240VAC)
Outputs:	Valve Power: 50Vdc PWM at 8 Hertz
	Recorder Analog Output: 0-10Vdc
	Alarm Relay Contacts: MAX. (125VAC/60Vdc @ 1A)
	Excitation Voltage: +/- 12Vdc @ 100mA
	Reference Voltage: +10Vdc @ 10mA
Weight:	3 Lbs. (1.4 kg)
Display Range:	0 - 1999 counts
Decimal Places:	1000 / 100.0 / 10.00
Alarm Band:	0 - 50% of full scale
Alarm Delay:	0 - 10 Seconds

18. **WIRING CONNECTIONS FOR P/N 999201.C**

1.	Power Neutral (115VAC)
2.	Power Hot (115VAC, 50/60 Hz, 25VA)
3.	Input Enable (115VAC)
4.	(+) 10 Vdc Reference Output for external remote *setpoint* command excitation
5.	(+) 12 Vdc Excitation Output for MagnaValve preamp (not used with VLP MagnaValve)
6.	(-) 12 Vdc Excitation Output for MagnaValve preamp (not used with VLP MagnaValve)
7.	(+) MagnaValve Output (in conduit or SO cord, does not have to be shielded)
8.	(-) MagnaValve Output (in conduit or SO cord, does not have to be shielded)
9.	Common Remote Setpoint (0Vdc)
10.	Input Remote Setpoint (0-10Vdc) (shielded cable)
11.	High Alarm Relay Contact
12.	Common Alarm Relay Contact
13.	Low Alarm Relay Contact
14.	Alarm Reset Input (90 -115VAC)
15.	(Not used)
16.	Input Current Shunt (0-5A ac) E.I. current shunt P/N 999200
17.	Input Voltage (0-5Vdc) (shielded cable)
18.	Common Current Shunt or Voltage (0Vdc)
19.	Common Recorder Signal (0Vdc)
20.	Output Recorder Signal (0-10Vdc) (shielded cable)

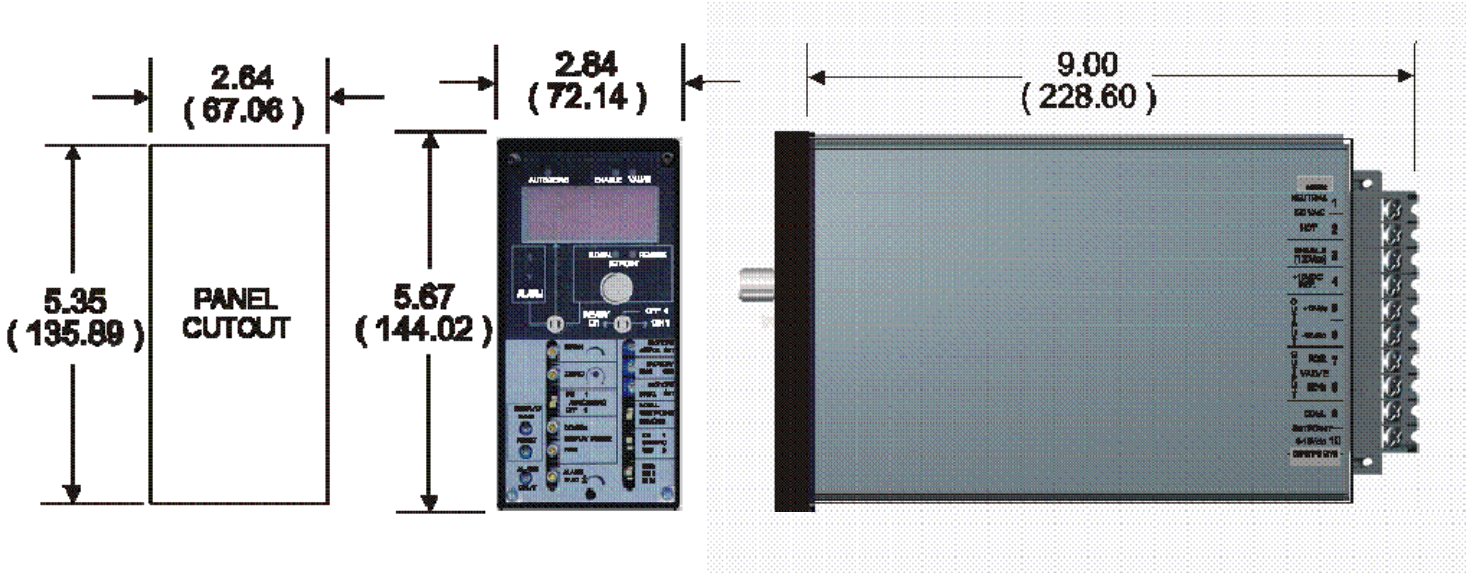
NOTE: Connect 100:5 current transformer leads to current shunt at terminals #16 and #18. Use 16AWG wire and keep it shorter than 10 feet to avoid losing signal strength. If the current transformer is further away than 10 feet it may be necessary to use larger wire size or mount the current shunt next to the current transformer and then connect the shunt to the AC controller using #18AWG shielded cable.

Motor speed controllers with 0-5 Vdc output load monitor may be connected to terminals #17 and #18 using shielded cable.

A small, 10µF, capacitor may be needed at the far end of the cable for recorder output to suppress electrical noise signals. The near end of the shield (screen) should be connected to the rear of the AC chassis green screw terminal.

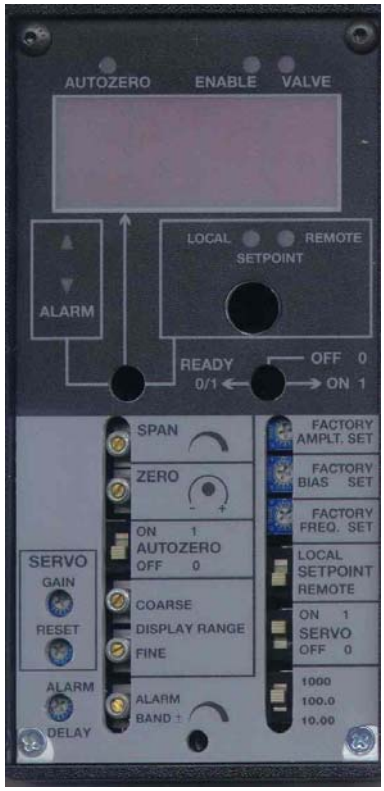
19. **SPECIFICATIONS (P/N 999201.C)**

Power:	115 VAC, 50/60 Hertz, 50VA No internal fuse (1amp recommended)
Inputs:	Current Shunt Input (0-5A). Electronics Inc. P/N 999200 (included)
	Voltage Signal Input (0-5Vdc)
	Remote Command Setpoint Input (0 -10Vdc)
	Enable (90 -115VAC)
	Alarm Reset (90 -115VAC)
Outputs:	Valve Power: 60 Vdc PWM at 8 Hertz
	Alarm Relay Contacts: 115VAC @ 1A
	Excitation Voltage: +/- 12Vdc @ 100mA
	Reference Voltage: +10Vdc @ 10mA
Weight:	4 Lbs. (1.8 kg)
Display Range:	0 - 1999 counts
Decimal Places:	1000 / 100.0 / 10.00
Alarm Band:	0 - 50% of full scale
Alarm Delay:	0 - 10 Seconds



20. CONTROLLER POWER REQUIREMENTS

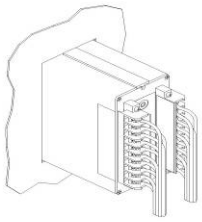
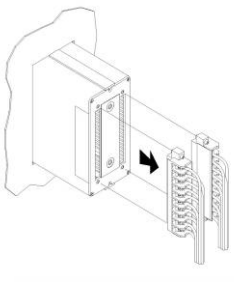
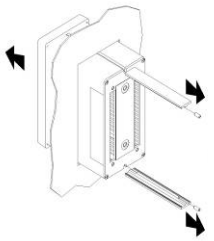
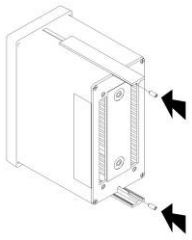
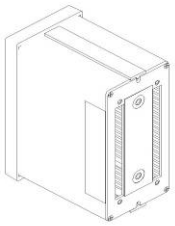
The model AC, FC and MC controllers were originally designed to operate from 120VAC (version A). In late 2001 a design change was made to accommodate 90-240VAC European applications (version B). Then, in 2002, for USA requirements, we upgraded the domestic version only, to version C. See notes below for the serial number ranges.

		
Version A	Version B	Version C
120VAC (replaced by version C) NOT AVAILABLE	**90-240VAC Range NOT AVAILABLE**	**115VAC ONLY**
S/N prior to 01219	**S/N 01219-001 to 02279-129**	**S/N 02279-130 and up**
NOTE: Relay contacts are rated 120VAC	**NOTE: Relay contacts are rated 120VAC**	**NOTE: Relay contacts are rated 115VAC**

Serial Number description: S/N 12345-678

Digits 1-2 are for year, (01=2001, 02=2002,etc.)
Digits 3-5 are manufacturing batch lot number
Digits 6-8 are sequence number within batch lot

21. **HOW TO RETURN A CONTROLLER FOR REPAIR**

1  Installed in panel. Turn “Off” all power sources to controller before going to step 2.	2  Remove terminal blocks and leave wires attached.
3  Remove Rails and Rail Mounting Screws. Slide controller forwards.	4  Slide Rails back on and install the Rail Mounting Screws.
5  Controller is ready to return.	6 Call 1-574-256-5001 ask for a Returns Goods (RG) Number (#) Ship controller with RG # to: Electronics Incorporated 56790 Magnetic Drive Mishawaka, IN 46545

END OF MANUAL