CONTROLLER V
RETROFIT MANUAL
FOR INDUSTRIAL BATTERY CHARGERS

FEATURING

RT05+ - dv/dt-di/dt CONTROL

MC05 - dv/dt-di/dt CONTROL

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The Power of Excellence

FM1179 REV D

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IMPORTANT SAFETY INSTRUCTIONS

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1. SAVE THESE INSTRUCTIONS. THIS MANUAL CONTAINS IMPORTANT SAFETY AND OPERATING INSTRUCTIONS.

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2. WORKING IN THE VICINITY OF A LEAD-ACID BATTERY IS DANGEROUS. BATTERIES GENERATE EXPLOSIVE GASSES DURING NORMAL BATTERY OPERATION. FOR THIS REASON IT IS OF THE UTMOST IMPORTANCE THAT EACH TIME BEFORE USING YOUR CHARGER, YOU READ AND FOLLOW THE INSTRUCTIONS PROVIDED EXACTLY.

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3. TO REDUCE RISK OF BATTERY EXPLOSION, FOLLOW THESE INSTRUCTIONS AND THOSE ON THE BATTERY.

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4. NEVER SMOKE OR ALLOW AN OPEN SPARK OR FLAME IN THE VICINITY OF THE BATTERY OR ENGINE.

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5. USE CHARGER FOR CHARGING A LEAD-ACID BATTERY ONLY. IT IS NOT INTENDED TO SUPPLY POWER TO AN EXTRA LOW-VOLTAGE ELECTRICAL SYSTEM OR TO CHARGE DRY-CELL BATTERIES. CHARGING DRY-CELL BATTERIES MAY CAUSE THEM TO BURST AND CAUSE INJURY TO PERSONS AND DAMAGE TO PROPERTY.

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6. NEVER CHARGE A FROZEN BATTERY.

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7. DO NOT OPERATE IN A CLOSED-IN AREA OR RESTRICT VENTILATION IN ANY WAY.

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8. DANGER: RISK OF ELECTRICAL SHOCK. DO NOT TOUCH UNINSULATED PORTION OF OUTPUT CONNECTOR OR UNINSULATED BATTERY TERMINAL.

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9. CAUTION: DISCONNECT SUPPLY BEFORE CHANGING FUSE.

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SECTION 2
RECEIPT AND INSPECTION OF THE AES RETROFIT KIT

Upon receipt of the RETROFIT KIT, the information on the shipping carton should be checked against your order. Any discrepancies should be reported to the nearest authorized representative. Remove the carton and inspect the pieces for damage. If there is any damage, save the carton for inspection and notify the carrier immediately.

Check the shipping paperwork against your order & specifications. Any discrepancies should be reported immediately to the nearest authorized representative. Be sure to verify that the control transformer is set for the **proper input voltage** and verify that the cell select board is set for the **number of cells** that the charger is rated for.

SECTION 3
INTRODUCTION

The MC05 and RT05+ RETROFIT KITS are microprocessor controlled, dv/dt-di/dt termination, flooded lead-acid FERRORESONANT industrial battery charger controllers.

A solid state, pre-programmed microcomputer provides total control of charge termination, preventing both undercharging and overcharging. The microcomputer incorporates built-in fault detection to ensure correct battery connection and smooth operation. The charge is terminated automatically when the control determines that the battery is fully charged.

SECTION 4
FEATURES OF THE MC05 AND RT05+ dv/dt-di/dt CONTROLS

4.1) CONTROL FEATURES:

4.1.1) Automatic five-second delayed start upon connection of a proper sized, good battery.

4.1.2) Battery voltage sensing determines if there is a proper sized battery connected to the charger. This prevents charging if there is a bad battery connected, no battery connected, bad battery-to-charger connection or battery voltage and charger mismatch.

4.1.3) Battery voltage and current are continuously monitored.

4.1.4) Automatic dv/dt-di/dt charge termination. (Voltage slope detection is current compensated.)

4.1.5) Negative battery slope termination to prevent overcharge/thermal runaway.

4.1.6) Automatic 12-hour "REFRESH" charge adds a top off charge to a fully charged battery. The charger will start a "refresh" charge 12 hours after a normal charge complete has been reached, assuming that the battery is not disconnected during this time.

4.1.7) Backup Timers prevent extended charging of a damaged battery. The first timer starts at the beginning of the charge cycle and runs for 9 hours. If the battery has not reached the 80% point, the charger will shutdown. The second timer starts at the 80% point and runs for 6 hours. If the charger does not terminate by then it will shutdown.

4.1.8) Automatic Shutdown Lockout will not allow a charge to start after a manual or problem shutdown occurs. Automatic Shutdown Lockout is cleared after the "Shutdown" battery is disconnected. This allows a charge to begin upon connection of a good, proper sized battery.

4.1.9) Automatic shutdown occurs for any of five failure conditions:

a). **Fault code "Lo U"** - Low volts per cell - the battery voltage is less than 1.7 vpc
b). **Fault code "Hi U"**- High volts per cell - greater than 2.8 or 2.88 vpc (set with 80% point)
c). **Fault code "dISC" -** Battery disconnected from charger during charge
d). **Fault code "dur"** - Charge time exceeded - backup timer expired
e). **Fault code "Lo I"-** Low charging current - charging current less than approximately 3 amps

4.1.10) Manual STOP switch - Will stop the charger from charging. When pressed with no battery connected, displays the delay start setting.

4.1.11) Delay Start switch - One to nine hours programmable delayed start thumbwheel switch. This rotary switch can be set from 0 to 9 hours to delay the start of charge.

4.1.12) Optional Automatic Equalization cycle every 5th cycle. This option can be enabled by DIPswitch (RT05+) or removal of W1 (MC05). For a charge cycle to be counted, the battery must be on charge at less than 80% for 1 hour or more from start of charge.

4.1.13) Equalize switch (RT05*PLUS* only)- This switch when depressed will turn on and off the three hour additional manual equalizing charge. When the equalize function is turned on, an "E" will be displayed in the leftmost digit of the display. The "E" will flash during the actual equalize charge cycle (manual and automatic). If auto-equalize has been selected, pressing this switch prior to connecting the battery will allow the number of charge cycles remaining until auto-equalize cycle to be displayed in the format E-#.

4.1.14) LED Test switch (RT05+ only) - All LED's and display segments will illuminate when this switch is pressed.

4.1.15) Display mode switch (RT05+ only):

1. Press once to display AMP-HRS RETURNED
2. Press twice to display TOTAL CHARGE TIME
3. Press three times to display average BATTERY VOLTAGE/CELL.

4.1.16) LED Indicators

1. "CHARGING" - charger is charging the battery
2. "80%" - the battery voltage is greater than 2.37 volts per cell.
3. "CHARGE COMPLETE" - the charge cycle has been terminated normally.
4. "SHUTDOWN" - the unit has shut down for a fault.

4.1.17) Digital Display Readout will display the following information:

1. Charging current
2. Fault codes
3. Delay start time
4. Charge time (RT05+ only)
5. Cool-down time (RT05+ only)
6. Battery voltage (RT05+ only)
7. Amp hrs returned (RT05+ only)
8. Watering cycle (RT05+ only)

4.1.18) Watering Function (RT05+ only) - A watering signal is provided at controller connector pin P3-3. This low current signal is normally logic level 'lo' and goes 'hi' at the end of every Charge cycle (watering mode). When in the watering mode the signal pulses on for 15 sec. and off for 15 sec. for a total of 20 repetitions or on continuously for 5 min (DIPswitch selectable). To prevent over-watering, this signal will not occur if the charge reaches 80% in less than 5 min. from start of charging. This signal is meant to interface with an external circuit for operating a watering valve. During watering the display shows 'H2O'. If equalize charge is selected, watering occurs immediately after the equalize cycle.

4.1.19) DIP SWITCH Settings (RT05+ only)

Switch number	**ON**	**OFF**
1.	Single di/dt compensation	Double di/dt compensation
2.	Normal dv/dt termination	Triple dv/dt termination
3.	60 Hz operation	50 Hz operation
4.	Display cool-down time	Do not display cool-down time
5.	Auto-Equalize Disabled	Auto-equalize enabled
6.	Normal current display	Double current display
7.	Water signal at End of Charge	Water signal at 90%
8.	80% point - 2.37 vpc	80% point - 2.45 vpc

NOTE: Normal factory settings are all switches in the ON position except for units designed for 50 Hz applications.

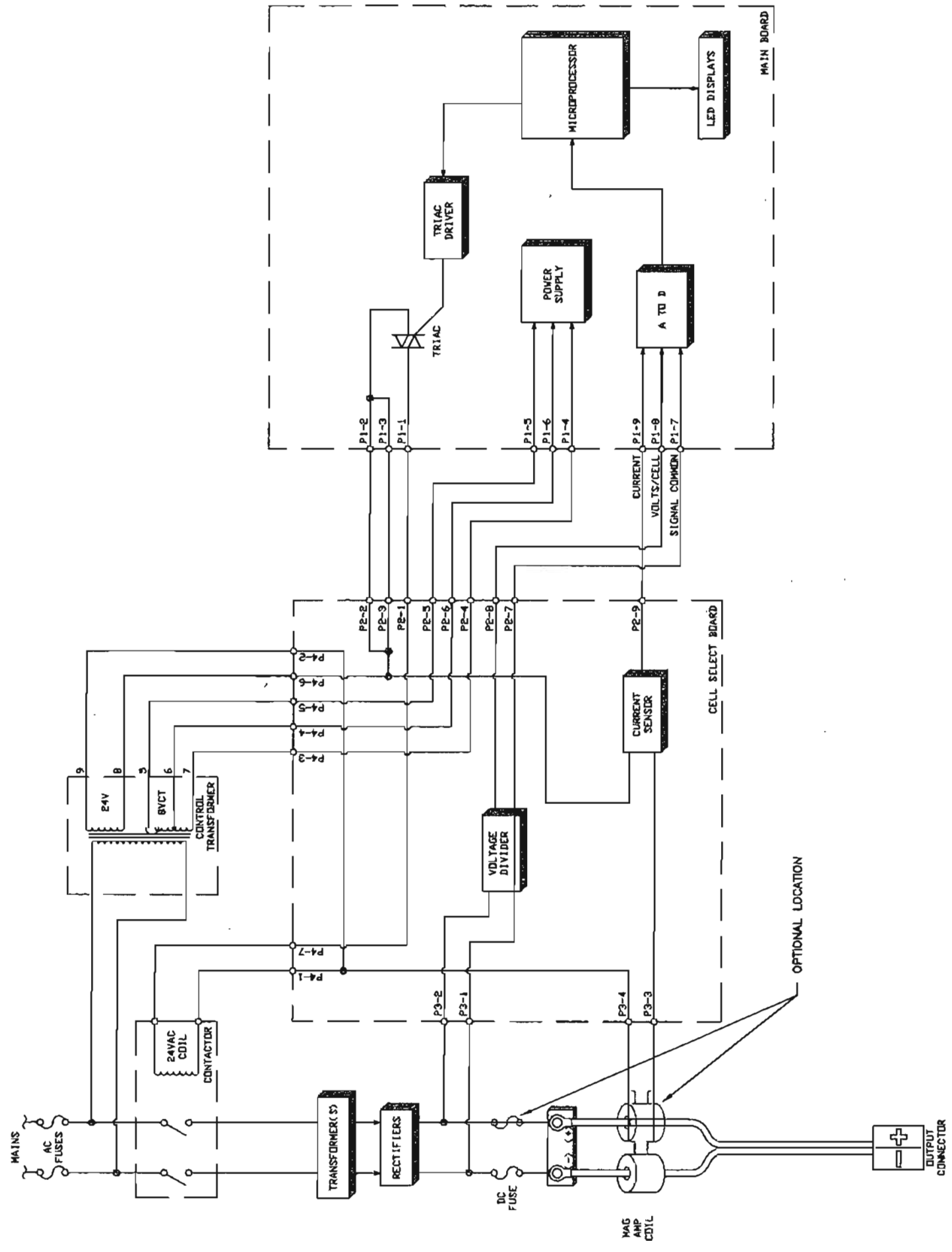
SECTION 5
INSTALLATION OF UNIVERSAL RETROFIT KITS

1. Remove AC power and any battery that may be connected to the charger that the RETROFIT is being installed in.
2. Before disconnecting any wires, be sure to make a sketch of the wire connection points for further reference.
3. Remove the line contactor from the charger.
4. Remove the control board from the charger.
5. The red board assembly will be connected between the AC fuses and the power transformers. It also will be connected to the control board and mag amp assemblies. Find a location for the red board assembly that will keep the assembly at least 1/2 inch from any conductive part or surface, allow easy connections to these components, and be within reach of the supplied cables.
6. Using the template FIGURE 1, mark the location for the (4) mounting bolts.
7. Place a guard in the charger to catch any metal shavings.
8. Drill the four holes in the charger with the drill size listed on the template.
9. Mount the red panel assembly with the hardware supplied with the kit.
10. Connect the green wire to the charger cabinet. This is the ground connection for the RETROFIT KIT.
11. Connect the power wires from the AC fuses to the side of the contactor labeled (AC INPUT). Note: for single phase units, connect the wires to poles A and C on the contactor.
12. Connect the wires from the power transformer to the side of the contactor that does NOT have the AC INPUT label on it.
13. Find an easily accessible location to mount the universal control box, so that the control is easy to see, and where the control cable will reach the cell select board on the red board assembly.
14. Using the template (FIGURE 2 for MC05 and FIGURE 3 for RT05+) mark the location for the mounting holes and for the control cable access.
15. Place a guard in the charger to catch any metal shavings.
16. Drill the five holes in the charger with the hole sizes listed on the template.

17. Feed the control cable through the clearance hole and fasten the control box with the hardware supplied.
18. Plug the control cable onto the 9-pin header on the cell select board making sure that the pin alignment is such that the wires lead away from the board and not over the top of it.
19. Place the mag amp over one of the output leads. Make sure that the location you select connects directly to the battery. Also be sure that the wiring harness can reach the red board assembly as well as the positive and negative lead output connection points.
20. Secure the mag amp to the wire using the ty-wraps supplied.
21. Connect the yellow wires marked (+) and (-) to the respective positive and negative output leads.
22. Connect the mag amp wiring harness to the 4-pin header on the cell select board, again taking care to ensure that the pin alignment is such that the wires lead away from the board and not over the top of it.
23. Verify that the control transformer's tap is set for the AC voltage that will be supplied to the charger.
24. Verify that all connections are tight and that there are no loose wires.
25. Apply AC power to the charger.
26. With no battery connected, the display should be in "IDLE" mode; a dash (--) will scroll across the display.
27. Press the STOP button to verify that the time delay switch has been set for immediate start (0:00).
28. Connect a properly sized battery to the charger. The control should count down from 9 to 0 and then start charging. The charging current will be displayed.

SECTION 6
INSTALLATION OF CUSTOM RETROFIT KITS

1. Remove AC power and any battery that may be connected to the charger that the RETROFIT is being installed in.
2. Before disconnecting any wires, be sure to make a sketch of the wire connection points for further reference.
3. Remove the line contactor from the charger.
4. Remove the control board from the contactor.
5. The red board assembly will be connected between the AC fuses and the power transformers. It also will be connected to the control board and mag amp assemblies. Find a location for the red board assembly that will keep the assembly at least 1/2 inch from any conductive part or surface, allow easy connections to these components, and be within reach of the supplied cables.
6. Using the template FIGURE 1, mark the location for the (4) mounting bolts.
7. Place a guard in the charger to catch any metal shavings.
8. Drill the four holes in the charger with the drill size listed on the template.
9. Mount the red board assembly with the hardware supplied with the kit.
10. Connect the green wire to the charger cabinet. This is the ground connection for the RETROFIT KIT.
11. Connect the power wires from the AC fuses to the side of the contactor labeled (AC INPUT). Note: for single phase units, connect the wires to poles A and C on the contactor.
12. Connect the wires from the power transformer to the side of the contactor that does NOT have the AC INPUT label on it.
13. Remove the existing control panel. Be sure to save the hardware.
14. Install the RETROFIT control panel using the hardware removed previously.
15. Plug the control cable onto the 9-pin header on the cell select board, making sure that the pin alignment is such that the wires lead away from the board and not over the top of it.
16. Place the mag amp over one of the output leads. Make sure that the location you select connects directly to the battery. Also be sure that the wiring harness can reach the red board assembly as well as the positive and negative lead, output connection points.
17. Secure the mag amp to the wire using the ty-wraps supplied.
18. Connect the yellow wires marked (+) and (-) to the respective positive and negative output leads.
19. Connect the mag amp wiring harness to the 4-pin header on the cell select board, again making sure that the pin alignment is such that the wires lead away from the board and not over the top of it.
20. Verify that the control transformer's tap is set for the AC voltages that will be supplied to the charger.
21. Verify that all connections are tight and that there are no loose wires.
22. Apply AC power to the charger.
23. With no battery connected, the display should be in "IDLE" mode; a dash (--) will scroll across the display.
24. Press the STOP button to verify that the time delay switch has been set for immediate start (0:00).
25. Connect a properly sized battery to the charger. The control should count down from 9 to 0 and then start charging. The charging current will be displayed.


MAIN BOARD
MICROPROCESSOR
LED DISPLAYS
TRIAC DRIVER
TRIAC
POWER SUPPLY
A TO D
P1-2
P1-3
P1-1
P1-5
P1-6
P1-4
P1-9
P1-8
P1-7
CURRENT
VOLTS/CELL
SIGNAL COMMON
CELL SELECT BOARD
P2-2
P2-3
P2-1
P2-5
P2-6
P2-4
P2-8
P2-7
P2-9
P4-2
P4-6
P4-5
P4-4
P4-3
P4-7
P4-1
CURRENT SENSOR
VOLTAGE DIVIDER
CONTROL TRANSFORMER
24V
8VCT
9
8
5
6
7
24VAC COIL
CONTACTOR
P3-2
P3-1
P3-4
P3-3
OPTIONAL LOCATION
MAINS
AC FUSES
TRANSFORMER(S)
RECTIFIERS
DC FUSE
MAG AMP COIL
OUTPUT CONNECTOR

CHARGER WARRANTY

APPLIED ENERGY SOLUTIONS warrants that each new and unused battery charger manufactured and supplied with good workmanship is free from any known mechanical defect, provided that (A) the product is installed and operated in accordance with the accepted industrial standards and in accordance with the printed instructions furnished by APPLIED ENERGY SOLUTIONS, (B) the product is used under normal conditions for which designed, (C) the product is not used in a corrosive, abnormally dusty or high humidity moisture condensing environment, and (D) the product is not subjected to misuse or negligence, and the product receives proper care, protection and maintenance under supervision of competent personnel.

Warranty Terms and Conditions

APPLIED ENERGY SOLUTIONS Retrofits are warranted for 1 Year[(1)] (3 years on parts)[(2)], which begins on the date of shipment from APPLIED ENERGY SOLUTIONS.

NOTES: [(1)] Warranty covers parts and labor, [(2)] Warranty covers parts only
AC fuses and DC fuses are not warranted unless they are found to be defective prior to use.

NON-TRANSFERABLE WARRANTY. This warranty is extended by APPLIED ENERGY SOLUTIONS only to the original user (purchaser) of new equipment from APPLIED ENERGY SOLUTIONS or one of its authorized agents. The product purchased under this agreement shall be used exclusively by the buyer. There shall be no third party beneficiary of this warranty.

REPAIR LIMITATIONS. APPLIED ENERGY SOLUTIONS has the right to site inspection and judgment of the claimed defects in any product covered by this warranty. APPLIED ENERGY SOLUTIONS' liability is limited to the repair of any defects found to exist by APPLIED ENERGY SOLUTIONS or, at APPLIED ENERGY SOLUTIONS' option, the replacement of the defective product.

APPLIED ENERGY SOLUTIONS and its authorized agents shall not be liable for direct or indirect damages in excess of such repair or replacement. In no event shall the purchaser be entitled to recover for contingent expenses from, but not limited to, telephone calls, telegrams, travel expenses, lodging, duties and taxes, labor, rental or replacement equipment, loss of business or profit or other commercial losses.

CONTINUED USE OF DEFECTIVE PRODUCTS. The continued use of an APPLIED ENERGY SOLUTIONS Industrial Battery Charger that is known to be defective VOIDS ALL WARRANTIES.

REPAIR OF MODIFIED EQUIPMENT. Except as authorized in writing the warranty specified does not cover any equipment that has been repaired by any party other than APPLIED ENERGY SOLUTIONS or its authorized agents. Except as authorized in writing the warranty specified does not cover any equipment that has been modified, mechanically or electrically, by any party other than APPLIED ENERGY SOLUTIONS.

WARRANTY EXPENSE LIMITATIONS. APPLIED ENERGY SOLUTIONS will limit the warranty expense of all chargers to be paid at a maximum of the original purchase price of the charger.

The provisions of this warranty shall not apply to product in use outside of the continental USA.

Except as stated above, all other warranties and conditions, either expressed or implied, including implied warranties of merchantability and fitness for a particular purpose, are excluded and buyer assumes all risk and liability resulting from the use of goods. APPLIED ENERGY SOLUTIONS neither assumes or authorizes any persons to assume for APPLIED ENERGY SOLUTIONS any other liability in connection with the sale or use of the goods sold and there are no oral agreements or warranties collateral to or affecting this written warranty.

When installing, servicing or operating these products, safe practices should be used by skilled and qualified technical persons.