Operating and Service Instructions

AT10 SERIES

MICROPROCESSOR-CONTROLLED

FLOAT BATTERY CHARGER

SINGLE PHASE INPUT

PRE-AT10.1 CONFIGURATION

(units shipped prior to 12/2001)

p/n JA0102-00
Rev. 11-2001

HOW TO READ THE AT10 MODEL NUMBER

Your **AT10** model number is coded to describe the options that are included. Please find the model number on the data nameplate and write it in the spaces provided below. Then follow the chart to determine the configuration of your battery charger.

AT10	-		-		-							
A		B		C		D	E	F	G	H	J	K

	DESCRIPTION	CODE	FEATURE
A	SERIES	AT10	AT10 CHARGER
B	NOMINAL DC OUTPUT VOLTAGE	012	12 Vdc
		024	24 Vdc
		048	48 Vdc
		130	130 Vdc
C	NOMINAL DC OUTPUT CURRENT	006	6 Adc
		012	12 Adc
		016	16 Adc
		020	20 Adc
		025	25 Adc
D	AC INPUT VOLTAGE	0	120/208/240 Vac 60 Hz [1]
		1	480 Vac 60 Hz [2]
E	BREAKER RATING (SEE TABLE)	1	STANDARD
		2	MEDIUM AIC
		3	HIGH AIC
	DESCRIPTION	**CODE**	**FEATURE**

	DESCRIPTION	CODE	FEATURE
F	FILTERING	0	UNFILTERED
		1	FILTERED
		2	BATTERY ELIMINATOR
G	ALARMS	1	NO ALARMS
		2	PRI ALARM BOARD
		3	AUX BOARD, STD BKRS
		4	AUX BOARD, M/H BKRS
H	LIGHTNING ARRESTOR	0	NOT SUPPLIED
		1	SUPPLIED
J	GROUND BUS	0	NOT SUPPLIED
		1	SUPPLIED
K	SPECIAL TREATMENTS	0	NONE
		1	FUNGUS PROOFING
		1	STATIC PROOFING
	DESCRIPTION	**CODE**	**FEATURE**

1 - 120/208/240 Vac multi-tap input - Unit is wired and shipped from factory at specified voltage.
2 - 480 Vac input requires addition of medium or high ampere interrupting capacity circuit breakers.

INPUT AND OUTPUT CIRCUIT BREAKER INTERRUPTING RATINGS

CODE E	TYPE	AC RATINGS (ALL INPUT VOLTAGES)	DC RATINGS (125 Vdc)
1	STANDARD	240 Vac: 10,000 AIC	10,000 AIC [4] 5,000 AIC [5]
2	MEDIUM AIC	240 Vac: 25,000 AIC 480 Vac: 18,000 AIC	10,000 AIC
3	HIGH AIC	240 Vac: 65,000 AIC 480 Vac: 25,000 AIC	25,000 AIC

4 - Rating applies to 130Vdc 16-25 Adc units.
5 - Approximate rating applies to all other units.

NOTE

The model number listed on the charger data nameplate does not include any field-installed options. Also, certain accessories (see Appendix B) are not included in the model number, even if they are shipped with the charger. Check off below any accessories that are included with your AT10.

- ☐ floor mounting brackets
- ☐ rack mounting brackets
- ☐ NEMA-2 type drip shield assembly
- ☐ NEMA-4/12/13 type enclosure
- ☐ cabinet heater assembly
- ☐ pad lock for front panel door
- ☐ external temperature compensation probe
- ☐ other

Please find the serial number on the data nameplate and record it here: _____

IMPORTANT SAFETY INSTRUCTIONS

READ AND FOLLOW ALL SAFETY INSTRUCTIONS

1. Before using this equipment, read all instructions and cautionary markings on: A) this equipment, B) battery, and C) any other equipment to be used in conjunction with this equipment.
2. This manual contains important safety and operating instructions, and therefore should be filed for easy access.
3. Remove all jewelry, watches, rings, etc. before proceeding with installation or service.
4. Do not touch any uninsulated parts of this equipment, especially the input and output connections, as there is the possibility of electrical shock.
5. During normal operation, batteries may produce explosive gas. *Never* smoke, use an open flame, or create arcs in the vicinity of this equipment or the battery.
6. Maintain at least 6 inches clearance from all obstructions on the top, bottom and sides of this equipment. Allow sufficient clearance to open the front panel for servicing.
7. Turn this equipment off before connecting or disconnecting the battery to avoid a shock hazard and/or equipment damage.
8. Connect or disconnect the battery only when the battery charger is off to prevent arcing or burning.
9. De-energize all ac and dc inputs to the battery charger before servicing.
10. Do not operate battery charger if it has been damaged in any way. Refer to qualified service personnel.
11. Do not disassemble battery charger. Only qualified service personnel should attempt repairs. Incorrect reassembly may result in explosion, electrical shock, or fire.
12. Do not install the battery charger outdoors, or in wet or damp locations unless specifically ordered for that environment.

SAVE THESE INSTRUCTIONS

TABLE OF CONTENTS

1. RECEIVING THE AT10

1.1. STORING THE AT10

If you store the AT10 for more than a few days before installation, you should store it in its original shipping container, and in a temperature controlled, dry climate. Ambient temperatures of 32 °F to 122 °F are acceptable. Storage should not exceed 2 years due to the limited shelf life of the dc filter capacitors when they are not in service.

1.2. REPORTING SHIPPING DAMAGE

If, on delivery of the AT10 or related goods, you discover any damage or shortage, make notation on all copies of delivering carrier's delivery receipt before signing, and notify the delivery person of your findings. If loss or damage is discovered after delivery, notify delivering carrier immediately and request an inspection. The manufacturer does not assume any liability for damage during transportation or handling.

Should the goods require an inspection by or return to the manufacturer, please contact your sales representative for further instructions. Any returned material must be properly packed in compliance with shipping regulations, and contain a Return Material Authorization (RMA) issued by the manufacturer.

1.3. UNPACKING AND INSPECTING THE AT10

Carefully remove all shipping materials from the AT10. Remove the AT10 from the shipping pallet for inspection. Save all shipping materials until you are sure that there is no shipping damage.

Once the AT10 is unpacked, inspect the unit for possible shipping damage, using the checklist below. If shipping damage has occurred, please refer to section 1.2 for proper reporting.

INSPECTION CHECKLIST

- ☐ Enclosure exterior and interior are not marred or dented.
- ☐ There is no visible damage to exterior or interior components.
- ☐ All internal components are secure.
- ☐ Printed circuit boards are firmly seated on their standoffs.
- ☐ All hardware is tight.
- ☐ All wire terminations are secure.
- ☐ The User's Manual is included.
- ☐ You received all items on the packing list.

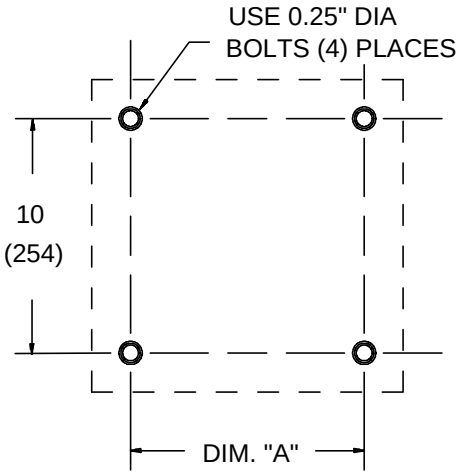
Once you have established that the AT10 is undamaged, find the appropriate section on the following pages for installation.

1.4. WALL MOUNTING THE AT10

In planning for wall mounting of the AT10 consider the following:

1. The wall must be strong enough to properly support the weight of the AT10. See the table on the next page for the approximate unit weight for each rating. The weight of your AT10 may be different from the table value, depending on options or accessories you ordered.
2. Placement of conduit entrances (use the knockouts on the sides or bottom of the charger to allow access for servicing without removing the unit from the wall).
3. The location:
   - Should be free of drips and splatter. If dripping liquids are a problem, install a drip shield, part number EI0191-00. See ordering information on page 64.
   - Should be between 32 and 122 °F (0 and 50 °C), with relative humidity between 5 and 95% non-condensing.
   - Must be free of explosive materials.
4. Maintain 6 inches of free air on top, bottom and both sides for cooling air.
5. Allow 3 feet front clearance for operation and maintenance.

To mount the AT10, install (4) 1/4 inch dia. bolts on the wall (rated to support the AT10 weight plus a safety factor of at least 2 times), as shown in the drawing on the next page. Place the AT10 on the bolts and tighten the bolts.



MOUNTING BOLT PATTERN

AT10 MOUNTING DIMENSION

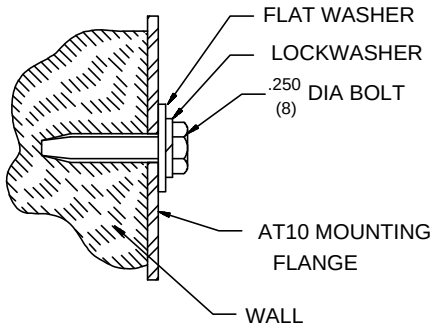
ENCLOSURE (See table below)	DIM. "A"
586	15 (381)
594	18.25 (464)

AT10 WEIGHT TABLE (LBS)

OUTPUT CURRENT	OUTPUT VOLTAGE 12V	24V	48V	130V
6A	35	50	65	70
12A	50	55	75	130
16A	65	90	95	180
20A	70	90	100	185
25A	75	95	105	195

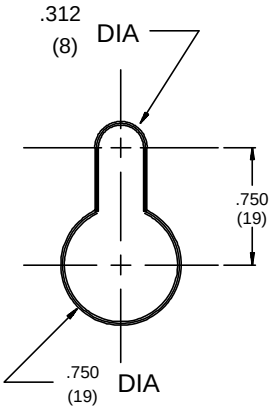
586 ENCL ↕ 594 ENCL

586 ENCL ↔ 594 ENCL



RECOMMENDED MOUNTING HARDWARE LOADING

DUAL DIMENSION IN (MM)



KEYHOLE SLOT USED ON AT10 MOUNTING FLANGE

FOR MORE INFORMATION, SEE OUTLINE DRAWING IN APPENDIX C

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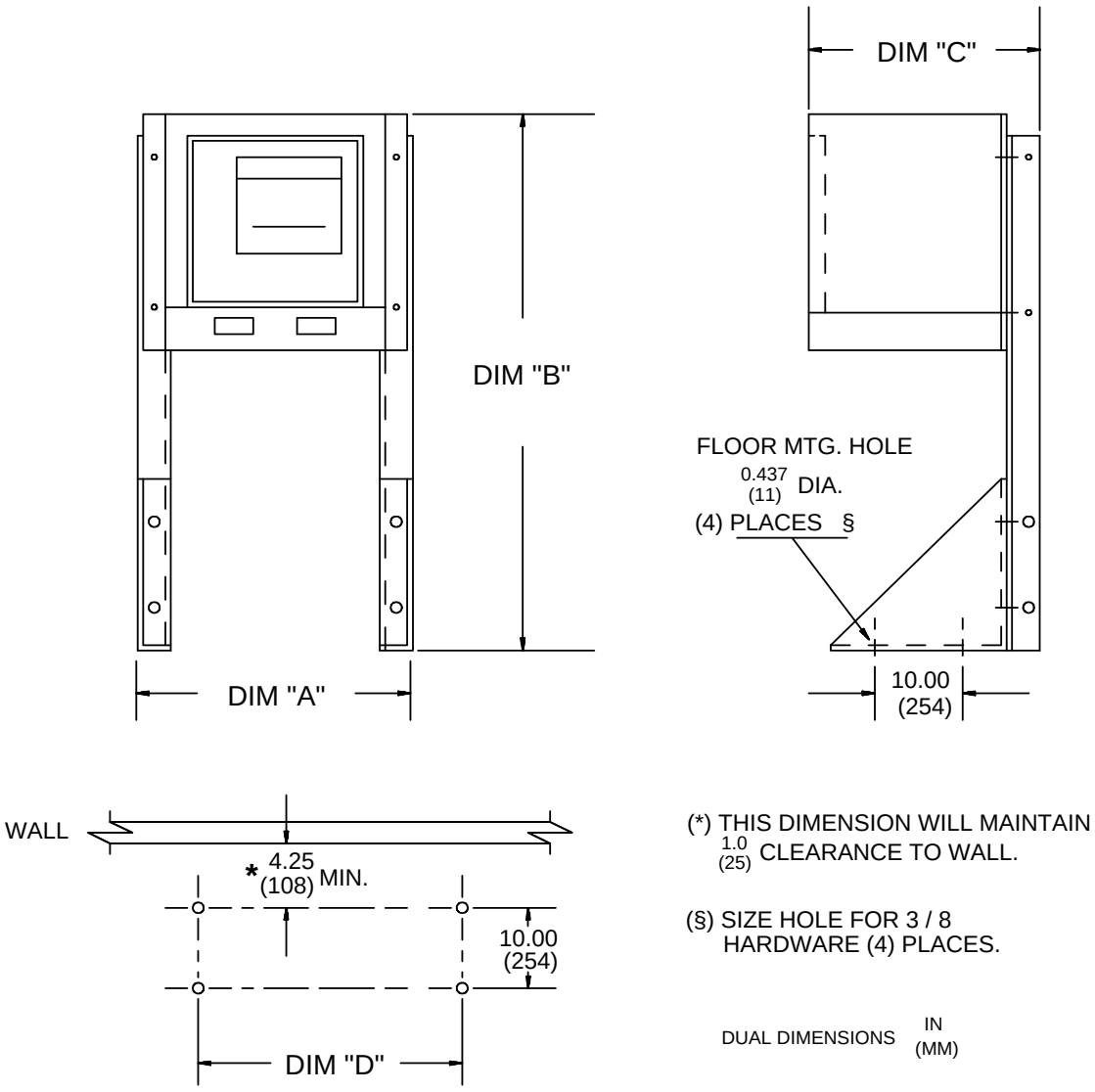
1.5. FLOOR MOUNTING THE AT10

To floor mount the AT10, you must use the floor mounting accessory kit, part number EI0192-00. The kit contains brackets that elevate the top of the AT10 approximately 47" above floor level, with provision for floor anchoring. The kit includes an instruction sheet (JA0083) showing assembly and mounting details.

You must locate the anchor bolt holes at least 4.25" from any wall, to allow clearance for the charger enclosure behind the mounting brackets. In addition, you must consider the following:

1. Placement of conduit entrances (use the knockouts on the sides or bottom of the charger to allow access for servicing without removing the unit from the mounting brackets).
2. The location:
   - Should be free of drips and splatter. If dripping liquids are a problem, install a drip shield, part number EI0191-00. See ordering information on page 64.
   - Should be between 32 and 122 °F (0 and 50 °C), with relative humidity between 5 and 95% non-condensing.
   - Must be free of explosive materials.
3. Maintain 6 inches of free air on top, bottom and both sides for cooling air.
4. Allow 3 feet front clearance for operation and maintenance.

The diagram on the next page provides outline details and a floor drilling plan.



FLOOR DRILLING PATTERN

F1-3R2

ENCLOSURE	DIMENSION, IN (MM)			
	A	B	C	D
586	16.50 (419)	46.63 (1184)	11.75 (298)	15.00 (381)
594	19.75 (502)	47.75 (1213)	14.25 (361)	18.25 (463)

1.6. RACK MOUNTING THE AT10

The AT10 can be installed in most relay racks with standard EIA hole spacing (see the table below for the allowable combinations). The rack mounting kit, part number EI0193-00, includes mounting brackets and the necessary hardware to install one AT10 battery charger. The kit includes an instruction sheet (JA0091) showing installation details.

When rack mounting the AT10, you must consider the following:

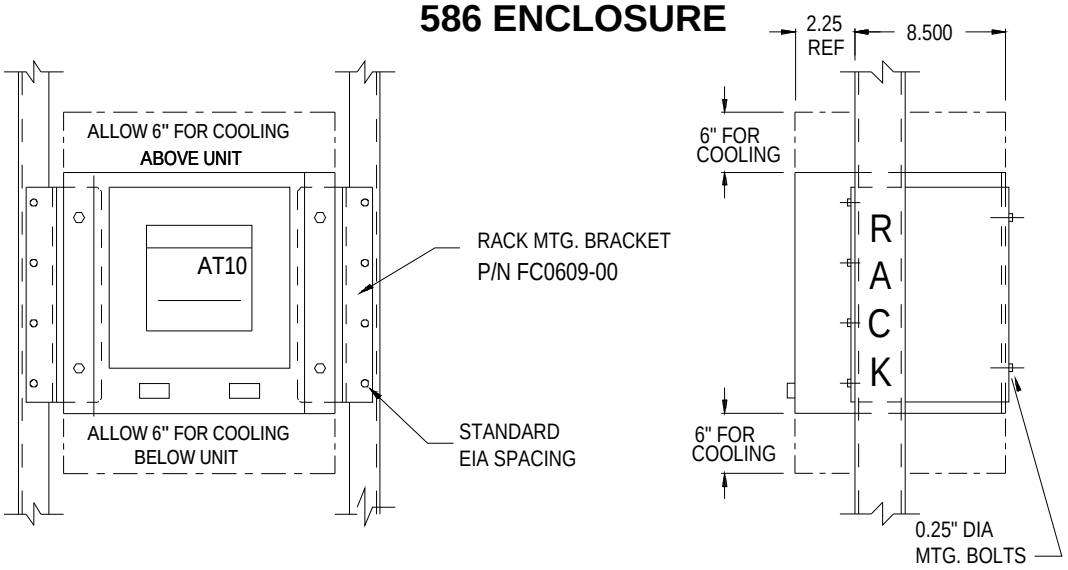
1. Placement of conduit entrances (be sure the knockouts on the sides or bottom of the charger are accessible after the charger is rack mounted).
2. The location:
   - Should be between 32 and 122 °F (0 and 50 °C), with relative humidity between 5 and 95% non-condensing.
   - Must be free of explosive materials.
3. Maintain 6 inches of free air on top, bottom and both sides for cooling air.
4. Allow 3 feet front clearance for operation and maintenance.

To rack mount the AT10, first install the brackets in the rack. Then install the AT10 onto the brackets using the hardware supplied. Provide at least 6 inches of air space above and below the AT10 in the rack for cooling. You do not need to modify the AT10 enclosure.

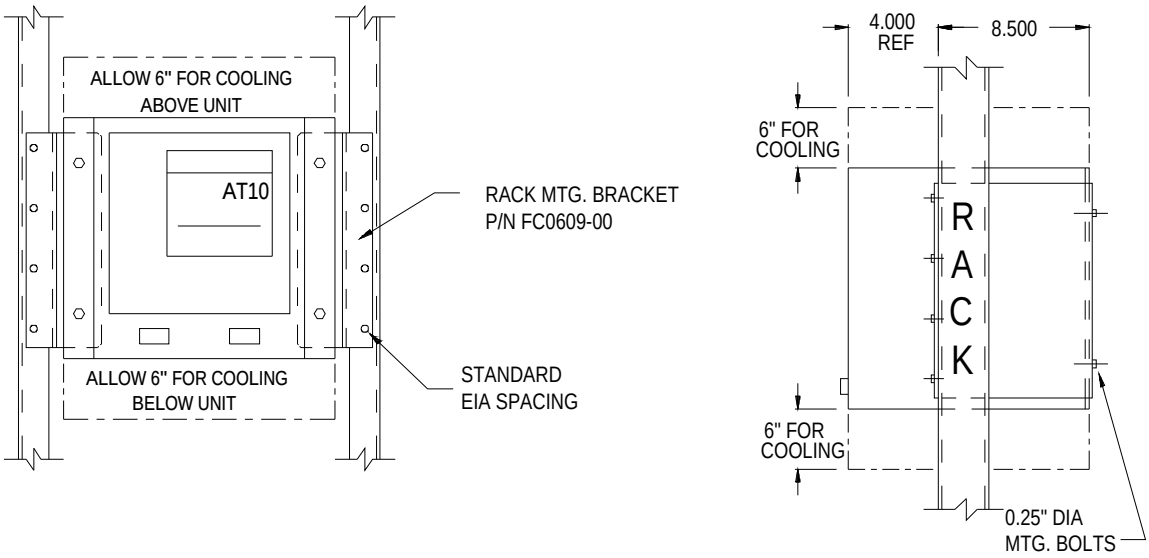
Outline dimensions are shown on the next page.

Charger Rating	RACK WIDTH		
	19 Inch	23 Inch	24 Inch
12 Vdc All	Yes	Yes	Yes
24 Vdc All	Yes	Yes	Yes
48 Vdc, 6 and 12 Adc	Yes	Yes	Yes
48 Vdc, 16 – 25 Adc	**No**	Yes	Yes
130 Vdc, 6 Adc	Yes	Yes	Yes
130 Vdc, 12 – 25 Adc	**No**	Yes	Yes

586 ENCLOSURE



594 ENCLOSURE



NOTES: 1. UNITS ARE INSTALLED FROM THE FRONT.

2. UNITS SHOWN ABOVE WITHOUT PENTHOUSE. IF PENTHOUSE IS USED ADD 7" TO TOP OF ENCLOSURE.

3. REFER TO THE OUTLINE DRAWING IN APPENDIX C FOR DIMENSIONS AND WEIGHTS.

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1.7. CHANGING TRANSFORMER TAPS

Before you wire ac power to the AT10, check the wiring of the main transformer T1, to be sure it is connected for your ac input voltage. The AT10 accepts an input voltage of 120, 208 or 240 Vac by changing jumpers on T1. No other changes are required. *The AT10 is wired at the factory for 240 Vac, except on special order*.

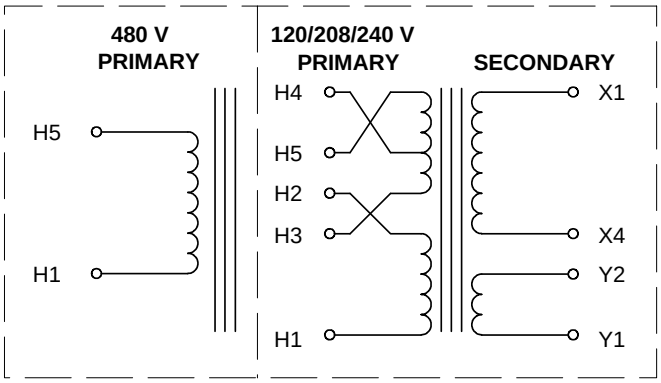
Exception: An AT10 battery charger rated for 480 Vac input uses a special transformer that has no taps or jumpers. The 480 Vac transformer cannot be used for any other input voltage.

Before changing the T1 taps, be sure that ac and dc supplies to the AT10 are turned off and locked out. Verify that no voltage is present by using a voltmeter at terminals TB1-L1 and TB1-L2 (ac), TB1(+) and TB1(-) (dc) and remote sense terminals (dc). Note that turning off the ac and dc circuit breakers on the AT10 *does not* eliminate live voltages inside the enclosure. Also de-energize wiring to the alarm contacts if the optional Primary Alarm Board is installed.

After verifying that all voltages within the enclosure are de-energized and locked out, change the jumpers on T1 as shown in the table on the next page. All transformers have (2) jumpers; always use both as specified in the table. The transformers used in the small enclosure (586) use piggyback quick-connect terminals. The transformers in the larger enclosure (594) use 10-32 stud terminals.

T1 CONNECTION TABLE

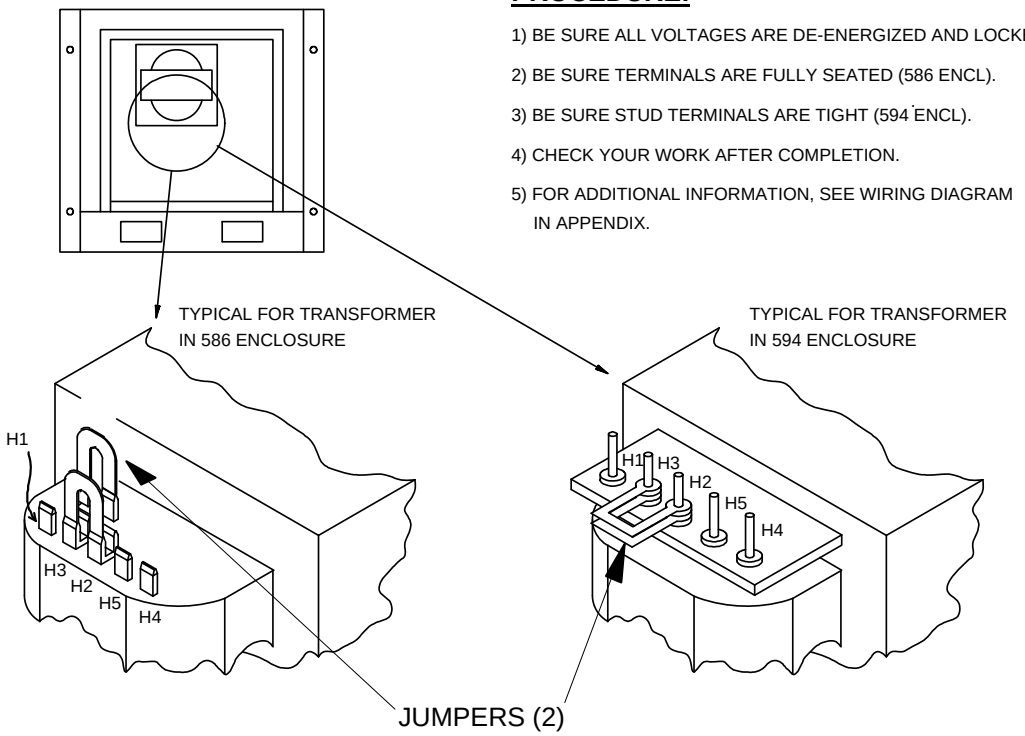
INPUT VAC	JUMPERS
120	H1-H3, H2-H5
208	H2-H4 (2) JUMPERS
240	H2-H3 (2) JUMPERS
480	NONE



TRANSFORMER SCHEMATIC

PROCEDURE:

1) BE SURE ALL VOLTAGES ARE DE-ENERGIZED AND LOCKED OUT.
2) BE SURE TERMINALS ARE FULLY SEATED (586 ENCL).
3) BE SURE STUD TERMINALS ARE TIGHT (594 ENCL).
4) CHECK YOUR WORK AFTER COMPLETION.
5) FOR ADDITIONAL INFORMATION, SEE WIRING DIAGRAM IN APPENDIX.



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1.8. MAKING THE AC INPUT CONNECTIONS

Follow these steps to connect ac power to the AT10:

1. Use a branch circuit breaker or fused disconnect switch, properly sized for the maximum input current of the AT10, as shown in the table below. This device should have lockout capability so that the ac input can be de-energized and locked out for maintenance. A time delay circuit breaker or slow-blow fuse is recommended.
2. Size the ac input wiring per the National Electric Code (NEC) and local codes for the rating of the branch circuit breaker or fused disconnect switch.
3. All specific requirements of your facility take precedence over these instructions.
4. *Be sure the AT10 main transformer, T1, is properly connected for your ac input voltage. See section 1.7.*
5. Remove the safety cover.
6. Run the ac wiring to terminals TB1-L1, TB1-L2 and TB1-GND on the I/O panel in the enclosure. Compression lugs, accepting wire sizes 14 - 6 AWG, are supplied for your convenience. To make these connections, strip the insulation ½" on the incoming wires and connect the wires to the appropriate lugs as shown on the next page.
7. Securely tighten the compression screws to 16 - 24 in-lb.
8. Reinstall the safety cover after you have made and checked all connections.

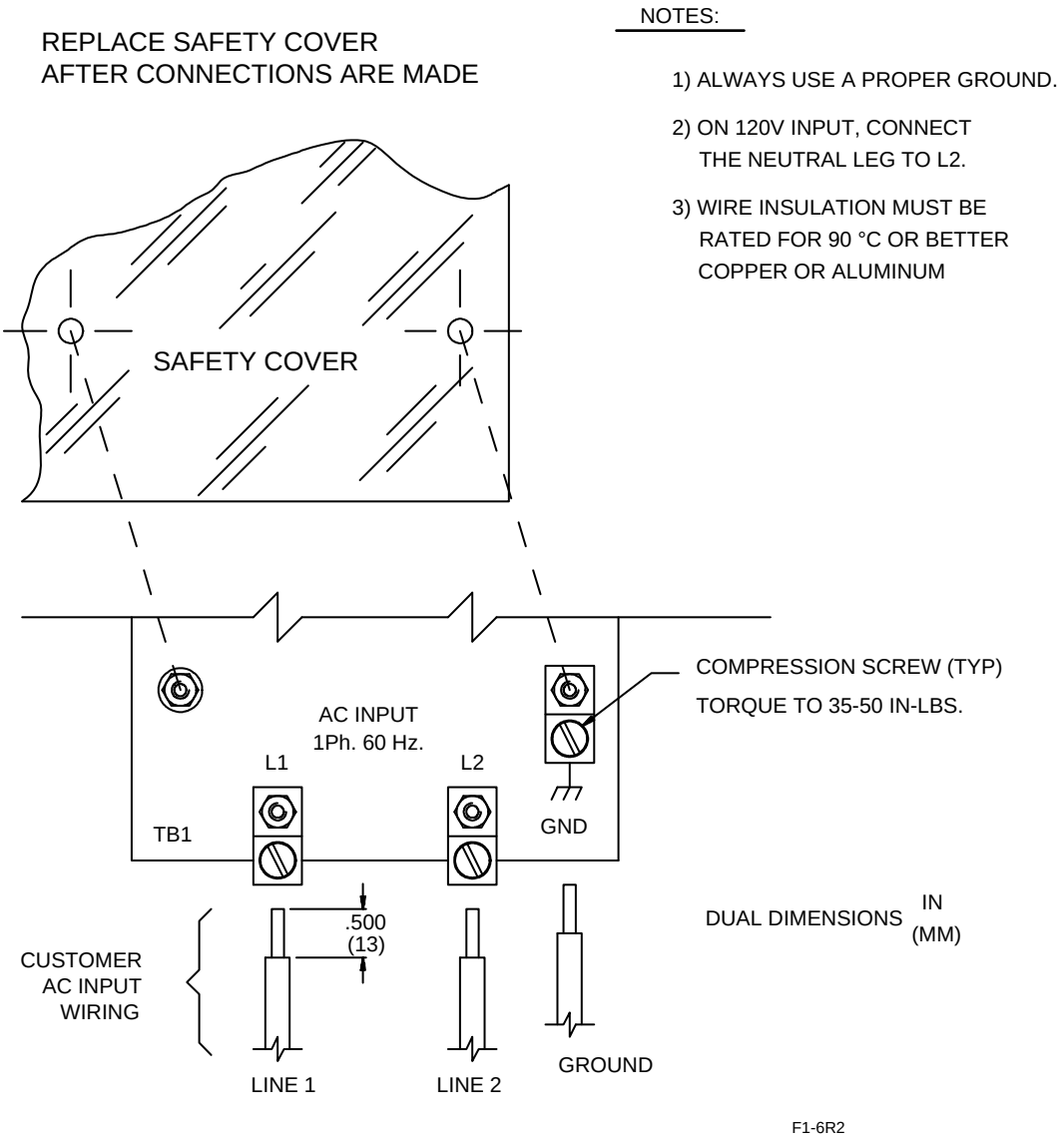
MAXIMUM INPUT CURRENT AT 120 VAC[1]

		OUTPUT VOLTAGE			
		12	**24**	**48**	**130**
OUTPUT CURRENT	**6**	2	4	8	14
	12	3	7	14	**30**
	16	4	9	18	32
	20	5	11	23	39
	25	6	14	29	49

[1] To determine the input current, Iac, for other input voltages, use the formula

$$I_{ac} = I_T \times \frac{120}{V_{ac}}$$

where V_{ac} is the new input voltage, and I_T is the input current from the table above.


REPLACE SAFETY COVER
AFTER CONNECTIONS ARE MADE
NOTES:
1) ALWAYS USE A PROPER GROUND.
2) ON 120V INPUT, CONNECT THE NEUTRAL LEG TO L2.
3) WIRE INSULATION MUST BE RATED FOR 90 °C OR BETTER COPPER OR ALUMINUM
SAFETY COVER
COMPRESSION SCREW (TYP)
TORQUE TO 35-50 IN-LBS.
AC INPUT
1Ph. 60 Hz.
L1
L2
TB1
GND
.500
(13)
DUAL DIMENSIONS IN (MM)
CUSTOMER AC INPUT WIRING
LINE 1
LINE 2
GROUND
F1-6R2

1.9. MAKING THE DC OUTPUT CONNECTIONS

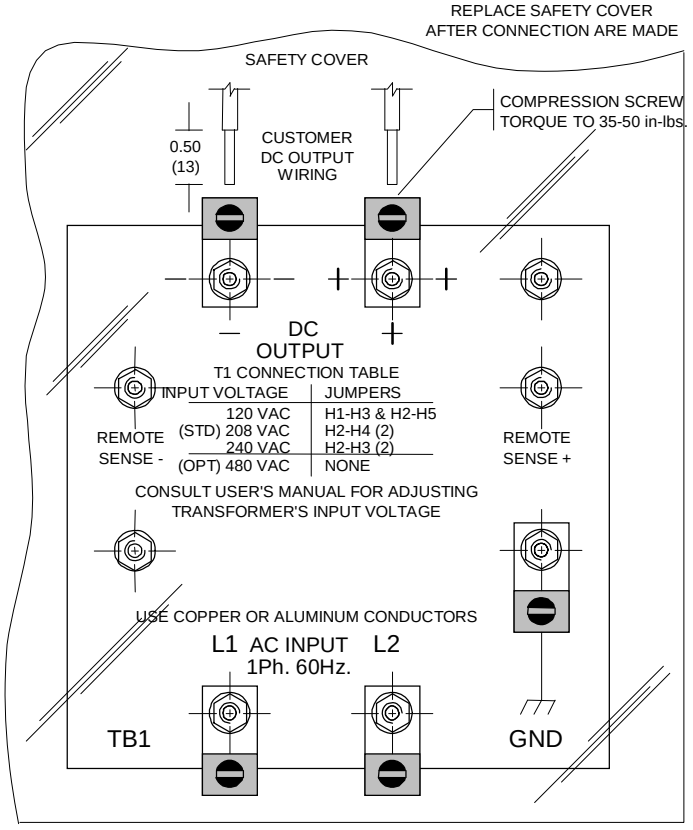
Follow these steps to connect the battery to the AT10:

1. Use a dc disconnect switch or circuit breaker between the AT10 and dc bus. This device should have lockout capability to allow the AT10 to be disconnected from the dc bus for maintenance.
2. Size the dc wiring to minimize voltage drop. The acceptable wire size depends on your installation. As a guideline, the voltage drop should not exceed 1% of nominal output voltage at full current. Refer to the table on the next page to determine the voltage drops for various wire sizes, currents and distances.
3. All specific requirements of your facility take precedence over these instructions.
4. The AT10 is factory wired to regulate output voltage at the output terminals. If you want to use remote sensing of the output voltage, see Section 1.10, "Wiring The AT10 For Remote Sensing."
5. Remove the safety cover.
6. Run the dc wiring to terminals TB1(+) and TB1(-) on the I/O panel in the enclosure. Compression lugs, accepting wire sizes 14 - 6 AWG, are supplied for your convenience. To make these connections, strip the insulation 1/2" on the incoming wires and connect the wires to the appropriate lugs as shown on the next page.
7. Securely tighten the compression screws to 35 - 50 in-lb.
8. Reinstall the safety cover after you have made and checked all connections.

VOLTAGE DROP PER 100' OF WIRE
(BASED ON COPPER AT 20°C/68°F)

AWG \ Idc		DC CURRENT (AMPS)				
		6	12	16	20	25
WIRE SIZE	16	2.5	5.0	6.7	8.2	10.5
	14	1.6	3.2	4.2	5.3	6.6
	12	1.0	2.0	2.6	3.3	4.2
	10	0.63	1.3	1.7	2.1	2.6
	8	0.4	0.8	* 1.1	1.3	1.7
	6	0.25	0.5	0.66	0.83	1.1
	4	0.16	0.32	0.42	0.52	0.65

* EXAMPLE:
100 FT. OF #8 AWG. WIRE AT 16 AMPERES HAS A 1.1 VOLT DROP.



NOTES: 1. WIRE INSULATION MUST BE RATED FOR 90°C OR BETTER.
2. DUAL DIMENSIONS in (mm).

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1.10. WIRING THE AT10 FOR REMOTE SENSING

You can wire the AT10 to regulate the output voltage at the battery teminals, instead of at the charger output terminals. Remote sensing does the following:

1. Compensates for voltage drop in the dc wiring between the AT10 and the battery.
2. Directly monitors the battery or dc bus voltage. The front panel meter displays the actual voltage on the dc bus.

You wire the AT10 for remote sensing by installing a two-wire cable from the AT10 remote sense terminals to the battery terminals. The AT10 control circuitry then measures the dc voltage at the battery terminals, and controls the output of the charger to maintain the battery voltage at the desired float or equalize voltage.

Note: If a remote sense wire opens, the AT10 detects the fault, shuts down the charger, and displays **ER 6** (See Section 3.2 for details).

CAUTION: The AT10 cannot protect against short circuits in the remote sense wiring. You should install a 1.0A fuse at the battery end of the remote sense cable.

To wire for remote sensing, follow the procedure and diagram on the next page.

If you ever need to disable remote sense, follow the steps below:

- De-energize and lock out all ac and dc voltages to the AT10. Check with a voltmeter.
- Disconnect the remote sense wires from the battery terminals first.

CAUTION: You must do the steps above first.

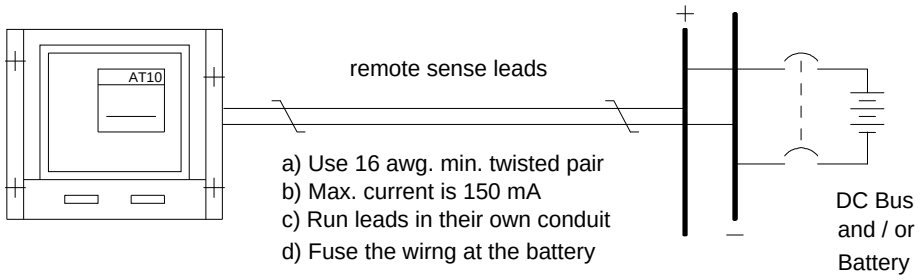
- Remove the remote sense leads from the remote sense (+) and (-) terminals on the I/O panel. Insulate each lead separately. Coil up the wires and leave them in the bottom of the charger, in case you want to wire for remote sense again in the future.
- Reconnect wire no. 74 to the dc output (+) terminal.
- Reconnect wire no. 72 to the dc output (-) terminal.

Restart the AT10 according to the instructions in section 2.

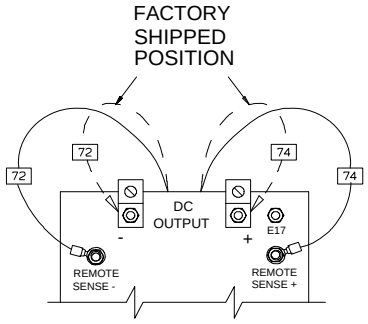
Step 1: De-energize and lock out all ac and dc voltages within the AT10 enclosure.
Check with a voltmeter.

Step 2: Remove safety cover.

Step 3: Wire the AT10 remote sense to the dc bus as shown below.



Step 4: Change the AT10 Sense Leads as shown below.

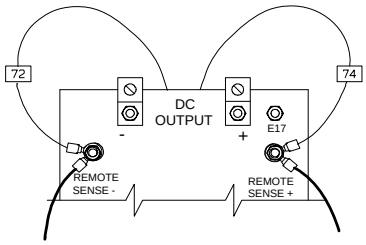


a) Move wire #74 from "DC Output +" to "Remote Sense +"

b) Move wire #72 from "DC Output -" to "Remote Sense -"

c) See step 5 for recommended hardware loading.

Step 5: Make the Remote Sense connections.

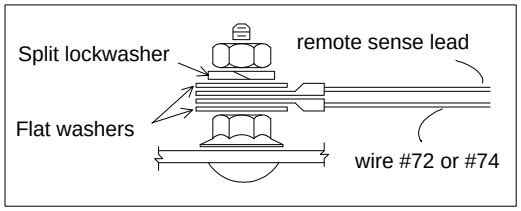


CUSTOMER SUPPLIED
NEGATIVE REMOTE
SENSE LEAD

CUSTOMER SUPPLIED
POSITIVE REMOTE
SENSE LEAD

a) Connect your remote sense leads as shown.

b) Recommended loading of remote sense leads:



c) Check your work; replace safety cover.

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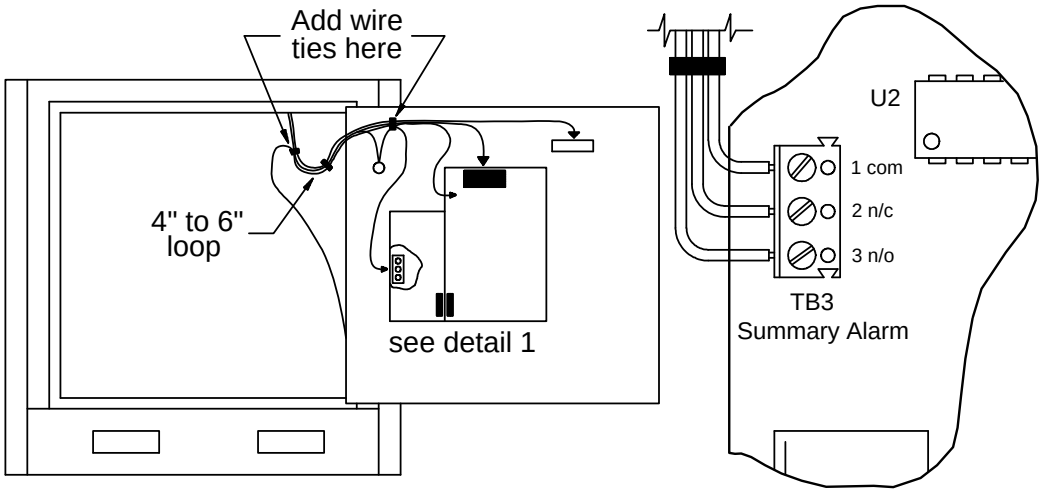
1.11. WIRING TO THE REMOTE ALARM CONTACTS (OPTIONAL)

Primary Alarm Board

The Primary Alarm Board, located on the back of the door, provides one form C summary alarm (common alarm) contact. Follow the procedure below to wire an annunciator to this contact. See section 2.2.8 for a description of the Primary Alarm Board.



DETAIL 1

Procedure:

1. Allow 30" of wire inside the enclosure. (excess will be trimmed)
2. Route wires to front door by following the existing harness through the door hinge as shown. Use (2) wire ties and allow 4" to 6" loop for the hinge.
3. Connect wires to TB3:
   - Trim wires to proper length for termination at TB3.
   - Strip 0.25" of insulation from wires.
   - Make connections at terminal block TB3.
   - Securely tighten the screws.

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Notes:

3. Alarm contacts are rated at 0.5A/125V ac or dc.
4. Terminal block is a compression type, accepting wire sizes 18 - 14 AWG.
5. Terminals are labeled in non-alarm condition.

Auxiliary Relay Board

The Auxiliary Relay Board is located in a separate enclosure (penthouse) mounted on top of the AT10 enclosure. This board provides one form C contact for each of the following individual alarms:

- High DC Voltage
- Low DC Voltage
- DC Output Failure
- AC Failure
- Ground Fault Detection (positive or negative)
- Summary Alarm

Follow the procedure below to wire annunciators to one or more of these alarm contacts.

1. Remove the top panel from the penthouse enclosure (on top of the main charger enclosure).
2. Route your remote annunciator wiring into the penthouse enclosure through one of the unused knockouts in the side of the enclosure.
3. Connect the wiring (use 18 - 14 AWG) to the appropriate terminals of TB4 on the back wall of the penthouse enclosure (as shown in the drawing at the right). Strip each wire 0.25", and securely tighten the terminal screws. The terminals are labeled in the non-alarm condition.
4. Replace the top panel on the penthouse enclosure.

Notes:

1. Alarm contacts are rated at 0.5A/125V ac or dc.
2. Terminal block is a compression type, accepting wire sizes 18 - 14 AWG.
3. Terminals are labeled in non-alarm condition.

1.12. INSTALLING TEMPERATURE COMPENSATION ASSEMBLY (OPTIONAL)

The temperature compensation assembly consists of a probe containing a temperature-dependent resistor in an epoxy module that you install near your battery. There are three steps in installing the assembly:

1. Mounting the probe assembly near the battery.
2. Installing an interconnection cable from the probe assembly to the AT10.
3. Removing R4 (on the rear of the front panel) and replacing it with the wiring from the temperature compensation probe.

The temperature compensation kit that you use depends on the battery type and the output voltage of your AT10. To find the correct part number for the kit, see the tables in Appendix B. Each kit contains detailed installation instructions. The main elements of the installation are outlined below.

WARNING:

High voltages appear at several points inside the battery charger. Use extreme caution when working inside the charger. Do not attempt to work inside the charger unless you are a qualified technician or electrician.

Disconnect and lock out all power to the battery charger before starting to remove or replace any components. Turn the ac power off at the distribution panel upstream from the battery charger. Disconnect the battery from the charger output terminals.

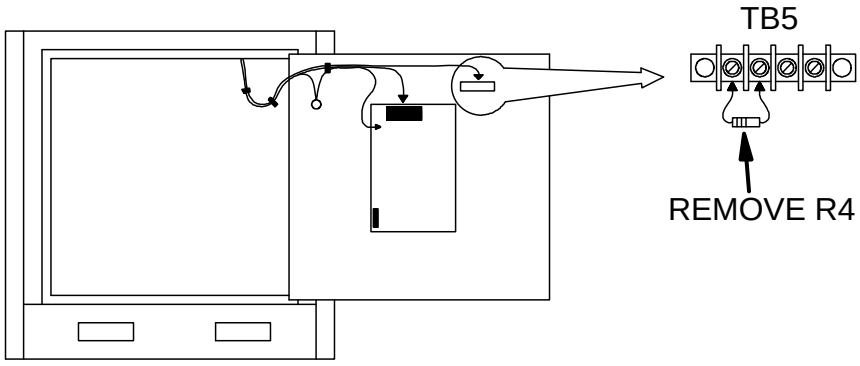
1. De-energize and lock out all ac and dc voltage sources to the AT10. Check with a voltmeter before proceeding.
2. Mount the probe on a clean, dry surface as close to the battery as possible, such as the battery rack. ***Do not*** mount the probe:
   - on the battery itself
   - on unpainted wood or bare galvanized metal.
   - on plastic surfaces
3. To apply the probe, clean the mounting surface with isopropyl alcohol, and allow to dry thoroughly. Remove the protective backing from the double-faced adhesive tape on the probe, and securely press the probe onto the surface.

4. Install the cable supplied with the temperature compensation probe kit:
   - Start at the AT10. The cable end with 2 quick-connect terminals will connect inside the enclosure. Leave 30 inches of cable inside the enclosure, and route the other end to the probe at the battery.
   - Run the cable in conduit if possible, but do not run in a conduit with any power wiring.
   - Coil up excess cable at the probe end.

Note: If the standard cable isn't long enough, cable assemblies are available in lengths of 50, 100 and 200 feet. See Appendix B for ordering information.

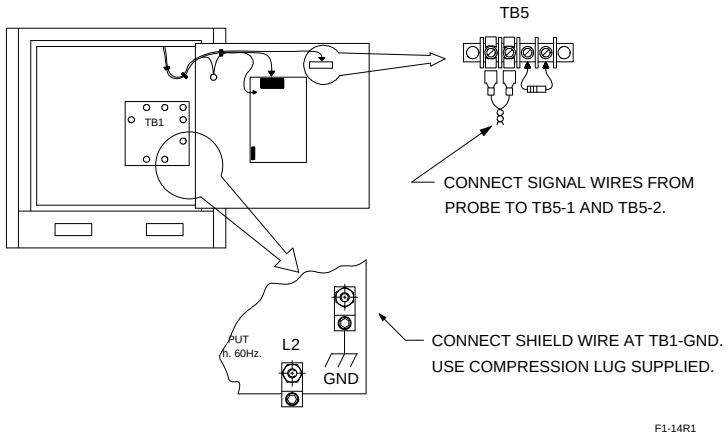
   - Be sure your wiring conforms to the NEC and your facility requirements.

5. Remove R4 from TB5 as shown below. Save R4 for possible future use by taping it to the bottom of the enclosure.



F1-13R1

6. Attach the interconnection cable to the AT10 as shown in the figure below:
   - Route the cable within the AT10 enclosure so that it runs with the wire harness to the back of the front panel, and reaches TB1 and TB5.
   - Terminate the shield wire on TB1-GND.
   - Locate the tabs that R4 was attached to (TB5-1 and TB5-2). Connect the quick-connect terminals on the end of the cable to the tabs (one terminal to each tab). Polarity is not important.
   - Using plastic wire ties, tie the interconnection cable to the existing wire harness. Be especially sure that the cable conforms to the service loop at the hinge end of the door.



7. At the battery, trim off the excess cable and connect it to the temperature compensation probe as shown in the figure to the right. Leave 1 – 2 feet excess cable as a service loop.

8. Check your work. Be sure that:
   - All connections are secure.
   - The shield is connected to ground *at the charger end only* (at TB1-GND).
   - R4 has been removed from TB5.

9. Restart the AT10 using the startup procedure in section 2. Adjust the output float and equalize voltages to the battery manufacturer's recommended values, using the AT10's front panel meter.

   If the temperature compensation probe, or the wiring from the probe to the AT10, is damaged and becomes an open circuit, the AT10 detects the damage and displays **Er 6** on the display. If this happens, the charger won't operate until the probe and/or wiring is repaired.

10. For temporary operation during repair to the probe or wiring, remove the probe interconnection cable quick-connect lugs from TB5, and reinstall R4 (refer to the diagram in step 4). Be sure to reinstall the cable after the repairs are finished.

Using temperature compensation

The probe senses the ambient temperature at the battery and adjusts the output float or equalize voltage to compensate for variations in temperature. If the ambient temperature increases, the AT10 output voltage decreases.

Please note the following:

- You should set the Float and Equalize voltages to the values recommended by your battery manufacturer for 77° F (25° C).
- The front panel meter shows the 77° F value for the Float or Equalize voltage, even if the battery is warmer or cooler than 77 °F.
- The actual output voltage of the AT10 may be different from the value on the front panel meter, if the battery is warmer or cooler than 77 °F.
- Use a digital meter to measure the actual output voltage of the AT10. If you know the temperature at the temperature compensation probe, you can use the graph below to determine that the output voltage is correct.

Example: Suppose you have a lead-acid battery whose temperature is 100 °F. As shown on the graph, the output voltage should be approximately 97% of the 77° F voltage. If the float voltage is set on the front panel to 132 Vdc, the actual output voltage will be 132 X 0.97 = 128 Vdc.

2. OPERATING THE AT10 BATTERY CHARGER

2.1. STARTING THE AT10

2.1.1. Understanding the startup sequence

The AT10 is shipped with factory settings for all of the operating parameters (float voltage, equalize voltage, etc.). When you start the AT10 for the first time, the factory settings control the operation of the charger. You can change the settings after you start the charger. The factory settings are shown in table 2.1 on the next page.

The AT10 startup routine takes about five seconds. The microprocessor that controls the AT10 initializes the charger by reading the settings that are stored internally. The control circuit then "soft starts" the charger, and the dc output voltage and current increase gradually to the rated value over a four second period.

2.1.2. Checking the installation

Be sure that you have followed the installation instructions carefully. Check the ac input supply voltage and the battery voltage, and be sure that they match the information on the AT10 nameplate. *Verify that the jumpers on the main transformer T1 are correct for your ac supply voltage.* Open the front panel, and check the battery polarity at the TB1 (+) and (-) terminals.

2.1.3. Starting the AT10

When you are sure that all connections to the AT10 are properly made, follow these steps to start up the AT10:

- Turn on the front panel dc circuit breaker. The digital meter indicates the battery voltage only. If the meter display doesn't light, *do not proceed*. Turn off the dc breaker, and check all connections and the battery polarity again. Also check the battery voltage. It must be above 50% of nominal voltage to turn on the display. If you can't find the problem, refer to the troubleshooting section of this manual.

CAUTION: If you try to turn on the dc circuit breaker with the battery connected in reverse polarity, the circuit breaker will immediately trip. Do not try to close the dc breaker again, since this may damage the battery charger. Correct the battery polarity before proceeding.

- Turn on the front panel ac circuit breaker. The digital meter displays the output voltage and current (see "Using the digital meter" on the previous page). You should hear a soft hum from the AT10 as the output current increases.

Note: If you turn on the ac breaker before the dc breaker, and you have a filtered model of the AT10, there is a possibility that the dc breaker will trip when you try to turn it on. This is caused by the filter capacitors discharging into the battery. To get around this problem, turn off the ac breaker. Restart the AT10 by turning on the dc breaker first.

- The green **FLOAT** indicator lights. Press the **CHRG MODE** key on the front panel. The **FLOAT** indicator goes off, and the yellow **EQLZ** indicator lights. Press the **CHRG MODE** key again to return the charger to the float mode.

The table below shows the factory settings for float and equalize voltage, equalize time, current limit setting, and alarm settings.

Table 2-1: FACTORY SETTINGS FOR ALL PARAMETERS

Parameter	Nominal Vdc			
	12	24	48	130
Float Voltage	13	26	52	131
Equalize Voltage	14	28	56	139
HVDC Alarm[1]	14.4	28.8	57.6	144
LVDC Alarm[1]	12	24	48	120
Equalize Time	24 Hours			
Equalize Method	Manual Timer			
Current Limit	110% of nominal output current			
HVDC Shutdown	Disabled			

[1] These settings apply if you have the optional Primary Alarm Board installed.

2.2. USING THE AT10 FRONT PANEL FEATURES

2.2.1. If the meter displays an error message

When you apply power to the AT10 for the first time, the microprocessor control circuit performs a diagnostic check of the system. If it finds anything wrong, it writes an error code to the display, such as **Er 1**.

Below is a list of the error codes. See section 3.2 for a full explanation of each error code.

Error Code	Explanation
Er 1	Resistor R2 is open or defective.
Er 2	Short circuit on output
Er 3	HVDC Shutdown has occurred
Er 4	Internal memory failure
Er 5	Battery is connected in reverse polarity[1]
Er 6	Failure in Remote Sense or Temperature Compensation wiring
Er 7	DC breaker is open, or internal or external output wiring is defective.

2.2.2. Selecting the meter mode

- Press the **METER MODE** key to change the meter display mode. The digital meter has four operating modes:
  1. Alternating between output voltage and output current. When the charger is in a timed equalize mode, the meter alternates between output voltage, output current, and equalize hours remaining.
  2. Displaying output voltage only. The **DC Volts** indicator lights.
  3. Displaying output current only. The **DC Amps** indicator lights.
  4. Displaying equalize hours remaining only. The **Eqlz Hrs Remaining** indicator lights. If the AT10 is not in a timed equalize mode, the meter displays the full programmed equalize time.
- When the charger is FIRST started, the meter alternates, showing output voltage and output current. The **DC Volts** and **DC Amps** indicators light alternately to indicate what is being displayed.

[1] This error code can appear only if the ac breaker is turned on first.

2.2.3. Selecting the Float or Equalize mode

The AT10 has 2 output voltage settings, Float and Equalize. Use the Float mode for all normal battery charging and to operate your dc system. Consult your battery data sheets for information on equalize charging your battery.

- Press the **CHRG MODE** key to change to the equalize mode.

If the equalize method is set to manual timer or auto-equalize timer, the charger will revert to the float mode at the end of the selected equalize time.

- You can press the **CHRG MODE** key at any time to change back to the float mode.

2.2.4. Choosing the Equalize method

Press the **EQLZ MTHD** key to choose the desired equalize method. The indicator next to the desired equalize method lights. Three equalize methods are available in the AT10:

- Manual Timer
- Manual Equalize
- Auto-Equalize Timer

These equalize methods are described below.

Manual Timer Method

Choose the manual timer method if you perform regularly scheduled equalize charging, or if you base your equalize charging on regular readings of the specific gravity of each cell of your battery (for lead-acid batteries). When your battery requires equalize charging, adjust the manual timer to 1 – 2 hours for each 100 AH of battery capacity (see section 2.3.3 to learn how to adjust the equalize time). The battery manufacturer can help you determine the best equalizing schedule for your battery.

After you select the manual timer method, press the **CHRG MODE** key to put the charger into the equalize mode. The **EQLZ** indicator lights. When the equalize timer is finished, the charger reverts automatically to the float mode, and the **FLOAT** indicator lights.

At any time during the equalize charge, you can switch the charger back to float mode by pressing the **CHRG MODE** key. The **FLOAT** indicator lights.

If there is an ac power failure during the equalize charge, the AT10 remembers the remaining equalize time. When ac power is restored, it resumes the equalize charge where it left off.

Manual Equalize Method

Choose the manual equalize method when you want to equalize charge the battery, but only when you are able to monitor the battery voltage and gassing rate. After you select the manual equalize method, press the **CHRG MODE** key to put the charger into the equalize mode. The **EQLZ** indicator lights.

Press the **CHRG MODE** key again to return the charger to the float mode. The **FLOAT** indicator lights.

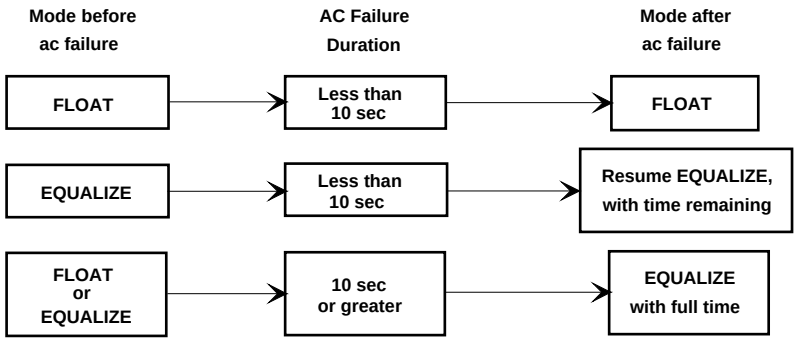
Never leave the AT10 unattended in the equalize mode with the manual equalize method selected, because a sustained overcharge may cause permanent damage to the battery.

Auto-Equalize Timer Method

Choose the auto-equalize timer method if you have a *flooded* (non-sealed) battery that is subject to infrequent discharges, or when the battery will be discharged by at least half of its rated capacity during an ac power failure. When ac power is restored to the charger, it turns on in the equalize mode automatically, and the **EQLZ** indicator lights. At the end of the equalize charging time that you select, the charger reverts automatically to the float mode, and the **FLOAT** indicator lights. At any time during the equalize charge, you can switch the charger back to float mode by pressing the **CHRG MODE** key. The **FLOAT** indicator lights.

Consult your battery manufacturer's instructions before using the auto-equalize timer method with sealed (valve-regulated) lead-acid batteries.

Whenever the ac supply fails for 10 seconds or longer, the auto-equalize timer is enabled. For shorter periods, the timer behaves as shown below:



Switching to Equalize Mode with Auto-Equalize Timer Method Selected

You can start an equalize charge at any time.

- Press the **CHRG MODE** key. The **EQLZ** indicator lights.

When the equalize timer is finished, the charger reverts automatically to the float mode, and the **FLOAT** indicator lights.

2.2.5. Testing the front panel indicators

- Press the **DOWN** key. This is also the **LAMP TEST** key.

All status indicators light, and the meter displays **8888**. If the optional Primary Alarm Board is installed, the alarm indicators light.

The **AC ON** indicator in the upper left corner is not tested by the **LAMP TEST** key. The **AC ON** indicator lights whenever ac power is present, and the ac circuit breaker is turned on.

2.2.6. Testing the Primary Alarm Relay

If you have the optional Primary Alarm Board installed, you can test the action of the summary alarm relay. Press and hold the **LAMP TEST** key for four seconds. The relay transfers. If you are monitoring the relay with a remote annunciator, the annunciator detects the alarm condition.

2.2.7. Testing the Auxiliary Relay Board

If you have the optional Auxiliary Relay Board installed, you can test the action of the alarm relays. Press and hold the **LAMP TEST** key for four seconds. The six auxiliary alarm relays on the Auxiliary Relay Board transfer; remote annunciators you connect to these relays detect the alarm condition.

2.2.8. Interpreting the alarm indicators (optional)

If you have the optional Primary Alarm Board installed, there are six indicators at the right side of the front panel. An indicator lights for each of the following alarm conditions:

- **HIGH DC VOLTAGE**: lights whenever the dc output voltage exceeds the specified alarm voltage setting. See section 2.3.4 to learn how to adjust the HVDC alarm setting.
- **LOW DC VOLTAGE**: lights whenever the dc output voltage is below the specified alarm voltage setting. See section 2.3.4 to learn how to adjust the LVDC alarm setting.
- **DC OUTPUT FAILURE**: lights whenever the charger cannot provide its full rated output voltage *or* its full rated output current. You cannot adjust this alarm setting.
- **AC INPUT FAILURE**: lights whenever the ac power supply to the charger is interrupted.
- **POS GND**: lights whenever leakage current from the battery positive terminal to ground exceeds a specified threshold. You can adjust the sensitivity of the ground fault detection from 5K to 50k ohms.
- **NEG GND**: lights whenever leakage current from the battery negative terminal to ground exceeds a specified threshold. You can adjust the sensitivity of the ground fault detection from 5K to 50k ohms.

The indicators light immediately when an alarm occurs. The alarm board also has a summary alarm relay with one form C contact, rated 0.5A, 125 V ac/dc. If an alarm condition lasts for 30 seconds or longer, the summary alarm relay contact transfers. When the alarm condition is corrected, the relay and all indicators reset automatically.

2.3. SETTING PARAMETERS IN THE AT10

2.3.1. Understanding Parameter Settings

You can change the settings of the AT10 while the charger is operating, using the front panel controls. The changes you make take effect immediately, and are saved internally . If the charger is taken out of service, and then later returned to service, it restarts using the last values you set. You can adjust the following parameters:

- Float voltage
- Equalize voltage
- Equalize timer (in hours)
- High dc voltage alarm setting (with optional alarm board)
- Low dc voltage alarm setting (with optional alarm board)
- Current limit value (in percent)
- High dc voltage shutdown feature (on or off)

Your choice of equalize method is also saved internally.

When you want to change any parameter, press the **EDIT/ENTER** key to put the AT10 into *Edit mode*. The meter display flashes about once per second, and the status indicators prompt you to adjust the respective parameter. You adjust each parameter by pressing the **UP** or **DOWN** key until the reading you want shows on the meter display. You can make the display scroll up or down continuously by pressing and holding the **UP** or **DOWN** key.

You cannot exceed certain upper and lower limits for the operating parameters. To see what the limits are for your charger, refer to the AT10 Specifications in Appendix A.

When you press the **EDIT/ENTER** key, the AT10 prompts you to adjust the first parameter in the list above (float voltage). When you obtain the value you want on the display, press the **EDIT/ENTER** key again. The AT10 saves the new setting internally, and then prompts you to adjust the second parameter. You continue this way to adjust the first three parameters (the first five if you have the optional Primary Alarm Board). If you want to skip adjusting any parameter, just press the **EDIT/ENTER** key again. The AT10 moves to the next parameter.

When you are finished adjusting the equalize timer duration (the low dc voltage alarm setting, if the Primary Alarm Board is installed), press the **EDIT/ENTER** key again. The AT10 saves all adjustments you made internally, and reverts to normal operation. The new settings take effect immediately.

Edit mode ends automatically if you don't press any front panel key within 25 seconds, and any change you made to the last setting is not saved.

2.3.2. Setting the Float and Equalize voltages

- Press the **EDIT/ENTER** key.

The **FLOAT** and **DC VOLTS** indicators light, and the display flashes the present value of the float voltage. Press and release the **UP** or **DOWN** key to increase or decrease the value in the display by one count, or press and hold the **UP** or **DOWN** key to scroll the value in the display upward or downward. When the display shows the float voltage you want to set, release the **UP** or **DOWN** key. If you go past the voltage you want, press the **UP** or **DOWN** key again to reach the voltage you want to set.

- Press the **EDIT/ENTER** key. The new float voltage setting is saved internally.

The **EQLZ** and **DC VOLTS** indicators light, and the display flashes the present value of the equalize voltage. Press and release the **UP** or **DOWN** key to increase or decrease the value in the display by one count, or press and hold the **UP** or **DOWN** key to scroll the value in the display upward or downward. When the display shows the equalize voltage you want to set, release the **UP** or **DOWN** key. If you go past the voltage you want, press the **UP** or **DOWN** key again to reach the voltage you want to set.

- Press the **EDIT/ENTER** key. The new equalize voltage setting is saved internally.

If you want to adjust the equalize timer duration, see the next section,

OR

if you want to exit the Edit mode now, press the **EDIT/ENTER** key again until the charger returns to normal operation.

Edit mode ends automatically if you don't press any front panel key within 25 seconds, and any change you made to the last setting is not saved.

2.3.3. Setting the Equalize Timer

- Press the **EDIT/ENTER** key until the **EQLZ HRS REMAINING, MANUAL TIMER** and **AUTO EQLZ TIMER** indicators light, and the display flashes the present value of the equalize timer duration in hours.

Press and release the **UP** or **DOWN** key to increase or decrease the value in the display by one count, or press and hold the **UP** or **DOWN** key to scroll the value in the display upward or downward. When the display shows the equalize time, in hours, that you want to set, release the **UP** or **DOWN** key. If you go past the number of hours you want, press the **UP** or **DOWN** key again to reach the number you want to set.

- Press the **EDIT/ENTER** key. The new equalize timer duration is saved internally. The timer setting works for both the manual timer and the auto-equalize timer.

2.3.4. Using the Primary Alarm Board (optional)

If you have the Primary Alarm Board installed in the AT10, the Edit mode automatically prompts you to adjust the high dc voltage and low dc voltage alarms. The Primary Alarm Board provides a red indicator on the front panel of the AT10 for each of the following alarm conditions:

- High DC Voltage
- Low DC Voltage
- DC Output Failure
- AC Input Failure
- Ground Fault Detection (+)
- Ground Fault Detection (-)

The indicators light immediately when an alarm occurs. The alarm board also has a summary alarm relay with one form C contact, rated 0.5A, 125 V ac/dc. If an alarm condition lasts for 30 seconds or longer, the summary alarm relay contact transfers. When the alarm condition is corrected, the relay and all indicators reset automatically.

The relay contact also transfers if the AT10 detects certain errors, and displays **Er 3**, **Er 6** or **Er 7** on the meter.

Setting the High DC Voltage Alarm

- Press the **EDIT/ENTER** key until the **HIGH DC VOLTAGE** indicator flashes, and the display flashes the present value of the high dc voltage alarm.

Press and release the **UP** or **DOWN** key to increase or decrease the value in the display by one count, or press and hold the **UP** or **DOWN** key to scroll the value in the display upward or downward. When the display shows the high dc voltage alarm point that you want to set, release the **UP** or **DOWN** key. If you go past the voltage you want, press the **UP** or **DOWN** key again to reach the voltage you want to set.

- Press the **EDIT/ENTER** key. The new high dc voltage alarm setting is entered into permanent memory.

Setting the low DC Voltage Alarm

- Press the **EDIT/ENTER** key until the **LOW DC VOLTAGE** indicator flashes, and the display flashes the present value of the low dc voltage alarm.

Press and release the **UP** or **DOWN** key to increase or decrease the value in the display by one count, or press and hold the **UP** or **DOWN** key to scroll the value in the display upward or downward. When the display shows the low dc voltage alarm point that you want to set, release the **UP** or **DOWN** key. If you go past the voltage you want, press the **UP** or **DOWN** key again to reach the voltage you want to set.

- Press the **EDIT/ENTER** key. The new low dc voltage alarm setting is entered into permanent memory.

The AT10 returns to the normal operating mode.

Adjusting Ground Detection Sensitivity

You can adjust the sensitivity of the ground detection alarm circuit. You must have a test resistor whose value is the sensitivity you want. You can adjust the sensitivity from **5K** to **50K** Ohms.

The potentiometer for adjusting ground detection circuit sensitivity is located on the Primary Alarm Board. It is the uppermost of the two potentiometers, labeled **R18**, **"SENS,"** as shown in the figure at the right.

Note: Do not try to adjust the lower potentiometer, R19, "BAL." This adjustment is made at the factory for proper circuit operation.

CAUTION: Before connecting or disconnecting a test resistor, de-energize and lock out all ac and dc voltage sources to the AT10. Check with a voltmeter before proceeding. Restart the AT10 only when necessary to make the sensitivity adjustment.

Remove the safety cover. Connect the test resistor between **TB1(+)** and chassis ground, as shown below. Adjust **R18** counterclockwise until the front panel indicator goes out, then adjust slowly clockwise until the **POS GND** indicator just lights. De-energize and lock out power to the AT10, then remove the test resistor and verify that the indicator goes out.

Now connect the test resistor between **TB1(-)** and chassis ground. Verify that the **NEG GND** indicator lights. If not, adjust **R18** clockwise until it does. Remove the test resistor.

Disabling the Ground Detection Alarm

You can disable the ground detection alarm circuit, and isolate the circuit from chassis ground. If your battery is normally grounded, or you want to defeat the alarm for any other reason, follow these steps:

- De-energize and lock out all ac and dc voltage sources to the AT10. Check with a voltmeter before proceeding. This includes remote sense wires if they were installed.
- Open the AT10 front panel, and locate jumper **J5** at the bottom of the Primary Alarm Board. Move the jumper to the **DISABLE** position. The **POS GND** and **NEG GND** indicators and the summary alarm relay will not respond to a ground fault.

Restart the AT10, following the instructions in section 2.1.

2.3.5. Setting the current limit value

The AT10 automatically limits its dc output current in case of overload or battery discharge. You can adjust the value of the current limit from 50% to 110% of rated current. The factory setting is 110%.

The charger must be in normal operation (not the Edit mode) to adjust current limit.

- Press and hold the **UP** key, then
- Press the **EDIT/ENTER** key.

The display flashes the value of current limit, *in percent of rated output.* Press and release the **UP** or **DOWN** key to increase or decrease the value in the display by one count, or press and hold the **UP** or **DOWN** key to scroll the value in the display upward or downward. When the display shows the current limit percent that you want to set, release the **UP** or **DOWN** key. If you go past the number you want, press the **UP** or **DOWN** key again to reach the number you want to set.

- Press the **EDIT/ENTER** key. The new current limit setting is saved internally.

Edit mode ends automatically if you don't press any front panel key within 25 seconds, and any change you made to the last setting is not saved.

2.3.6. Enabling the High DC Voltage shutdown feature

The AT10 has a built-in high dc voltage shutdown feature. In case of any misadjustment or internal failure that results in a continuous output voltage that is too high, the AT10 shuts down after 30 seconds to protect the battery. The digital display shows **Er 3,** and the summary alarm relay contact transfers. *The AT10 is shipped with the high dc voltage shutdown feature disabled.*

If you have the Primary Alarm Board installed, you can adjust the high dc voltage shutdown (the setting is the same as the high dc voltage alarm setting). If the Primary Alarm Board is not installed, the shutdown setting is approximately 2.5% higher than the equalize voltage setting and is not adjustable

The charger must be in normal operation (not the Edit mode) to enable the high dc voltage shutdown. To enable the shutdown feature:

- Press and hold the **UP** key, then
- Press the **CHRG MODE** key.

The **HIGH DC VOLTAGE** indicator lights, and the display flashes **On**. You can toggle the shutdown feature **OFF** and **On** by pressing the **CHRG MODE** key repeatedly. If you don't press any key within 2.5 seconds, the last state indicated (**On** or **OFF**) is saved internally. Note that you *don't* use the **EDIT/ENTER** key for this feature.

If the AT10 shuts down because of a high dc voltage, the meter display shows error code **Er 3**. Reset the charger by turning the ac breaker off, then on again.

2.3.7. Adjusting the Voltmeter Accuracy

The AT10 voltmeter is adjusted at the factory to display the actual output voltage within ±1%. If you replace any component that affects meter accuracy, such as the main control PC board or R4, you should readjust the meter.

First, use the EDIT procedure to adjust the float voltage to the desired value. See section 2.3.2 for instructions on setting the float voltage. Then,

- Press and hold the **UP** key, then
- Press the **EQLZ MTHD** key.

The **DC VOLTS** **METER MODE** indicator lights, and the meter display flashes the output voltage reading. Measure the output voltage of the AT10 using a dc meter accurate to ±0.25% or better.

While watching the meter connected to the AT10 output (not the front panel meter), press the **UP** or **DOWN** key until the actual output voltage is the desired float value.

Each time you press **UP** or **DOWN**, you change the AT10's output voltage by a small amount. Continue to press **UP** or **DOWN** until the actual output voltage agrees with the front panel reading within ±1%

Note: Allow one or two seconds for the output voltage to stabilize each time you press the **UP** or **DOWN** key.

When you are finished adjusting the output voltage, the AT10 waits 5 seconds, then the display returns to normal operation.

2.3.8. Using the front panel security feature

The AT10 charger is shipped with all the front panel keys enabled. You can disable these front panel functions:

- Selecting Equalize method
- Changing settings using the **EDIT/ENTER** key
- Toggling the high dc voltage shutdown feature
- Adjusting current limit

Open the front panel, and locate the small plastic jumper **J4** in the center of the main control board. Move the jumper to the **DISABLE** position. Only the front panel **METER MODE** and **CHRG MODE** keys work. All indicators still work normally.

2.4. Performing routine maintenance

WARNING:

High voltages appear at several points inside the battery charger. Use extreme caution when working inside the charger. Do not attempt to work inside the charger unless you are a qualified technician or electrician.

Disconnect and lock out all power to the battery charger before starting any maintenance procedures. Turn the ac power off at the distribution panel upstream from the battery charger. Disconnect the battery from the charger output terminals.

2.4.1. Keep it clean

The AT10 charger is cooled by natural convection. At least once a year, vacuum the vents at the top and bottom of the enclosure to ensure that there is an adequate supply of cooling air. If you have an extremely dusty environment (especially if airborne dust is conductive), *carefully* vacuum out the interior. Be sure to clean surfaces of circuit boards, and around electrical terminals.

The AT10 is rated for operation up to 50 °C (122 °F). If your charger is in a warmer environment, contact your sales representative for operating information.

2.4.2. Check power and signal connections

Check the tightness of all field connections inside the charger, and connections to the battery. A loose or corroded connection at the battery terminals can be a fire or explosion hazard, and may cause erroneous operation of the AT10 charger.

2.4.3. Check remote sense wiring

If you wired the AT10 charger for remote sense, check the signal connections to the battery or load, and check the wiring to be sure the insulation is in good condition. If there is a failure of the remote sense signal wiring, the AT10 charger shuts down, and displays the error code **Er 6.**

2.4.4. Check temperature compensation probe (optional)

If you are using the optional temperature compensation probe, be sure that the probe is securely installed. Be sure the connectors and the wiring from the probe to the AT10 charger are in good condition.

If there is a failure of the temperature compensation probe, or the wiring, the AT10 charger shuts down, and displays the error code **Er 6**.

2.4.5. Measuring the output ripple voltage (filtered models only)

If your AT10 charger is a filtered model, at least once a year measure the ac ripple voltage at the battery terminals. Use an rms responding ac voltmeter.[1] The ripple voltage should be no more than 30 mVac rms, if the battery ampere-hour capacity is at least 4 times the output current rating of the charger.

If you suspect that the output ripple voltage is too high, see "Output ripple voltage too high" in the troubleshooting chart, section 3.4.

2.4.6. Viewing the voltage and alarm settings

You can review the parameter settings in the AT10 charger by pressing the **EDIT/ENTER** key on the front panel. Each time you press the key, a different parameter displays, in the following order:

- Float voltage
- Equalize voltage
- Equalize time (in hours)
- High dc voltage alarm setting (with optional alarm board)
- Low dc voltage alarm setting (with optional alarm board)

To view the current limit setting, see section 2.3.5.

[1] Don't use a dc voltmeter. The ripple voltage on a battery is a very small ac voltage.

SAMPLE PREVENTIVE MAINTENANCE PROCEDURE

AT10 BATTERY CHARGER

Suggested frequency: every 6 months

Maintenance date _____ Performed by_____

Step	Instructions	Results
Clean battery charger	• All vents clean and open. • Remove dust and debris from inside of unit.	☐ OK ☐ OK
Check all electrical connections and wiring	• TB1 connections all tight. • Internal wiring connections tight, slip-on connectors fully seated. Wire and lug insulation in good condition. • Terminations at battery or bus are tight and corrosion free.	☐ OK ☐ OK ☐ OK
Check integrity of remote sense or temperature compensation wiring	• Remote sense wiring. • Temperature compensation wiring. • Temperature compensation probe.	☐ OK ☐ OK ☐ OK
Check ac input voltage	• Measure at TB1 L1 and L2 using ac voltmeter. Must be within +10%, -12% of nominal.	Input_____ Vac
Check dc output voltage	• Measure at TB1 (+) and (-) using dc voltmeter. Should agree with front panel voltmeter within 1%, and must be correct values for your battery. If the AT10 is using a temperature compensation probe, see the graph on page 23 to determine the correct battery voltage.	Float_____ Vdc Equal._____ Vdc
Check ripple voltage	• Measure at battery terminals using ac voltmeter set to millivolts scale. Check against specification in appendix A of User's Manual.	Ripple_____ mVac

Test font panel indicators	• Press **LAMP TEST** key on front panel.	☐ OK
Test alarm relays (optional)	• Press **LAMP TEST** key and hold for 4 seconds. Alarm relay(s) will transfer.	☐ OK
Exercise front panel controls	• Switch from float to equalize, then back to float. • Turn off the dc circuit breaker. **Er 7** should appear on display (requires at least 5% of rated output current). Reset breaker.	☐ OK ☐ OK
	• Cycle through meter modes.	☐ **VOLTS** OK ☐ **AMPS** OK ☐ **HOURS** OK
	• Cycle through equalize methods.	☐ **MANUAL TIMER** OK ☐ **MANUAL EQLZ** OK ☐ **AUTO EQLZ TIMER** OK
	• If Primary Alarm board is installed, turn off ac circuit breaker. The **AC INPUT FAILURE** indicator should light. Reset breaker.	☐ Alarm OK
Check voltage and alarm settings	• Use **EDIT/ENTER** key to scroll through settings. • Press **UP** and **EDIT/ENTER** keys together to check current limit setting.	☐ **FLOAT** OK ☐ **EQUALIZE** OK ☐ **HVDC** alarm OK ☐ **LVDC** alarm OK Current limit _____ %
Final checks	• Be sure safety cover is in place. • Restore charger to normal operation. • Close latch on front panel; close padlock if installed.	☐ OK ☐ OK ☐ OK

A full-size reprint of this Preventive Maintenance Procedure is available. Ask your sales representative for form JD0064.

3. SERVICING THE AT10

3.1. A STEP-BY-STEP TROUBLESHOOTING PROCEDURE

The AT10 battery charger is fully tested and calibrated at the factory, and should work for years with a minimum of attention. If you do encounter trouble, there are three steps you should take to find the problem and return the charger to service.

1. Check the front panel meter for an error code. The AT10 is able to diagnose common problems with the battery charger, or with the application or installation. If the front panel displays an error code, see section 3.2, *Interpreting front panel error messages*, in for help in interpreting the code and solving the problem.
2. If the charger does not work properly, but there is no front panel error code, open the front panel, and press the reset button at the lower right corner of the control circuit board. This will return the charger to normal operation as long as there is no internal component failure.

   Note: Do this only once. If the charger does not resume normal operation, go to the next step.
3. If the charger still does not work properly, make a list of the symptoms that you observe, then turn to *Using the troubleshooting chart* in section 3.3. The troubleshooting chart relates common trouble symptoms to their causes, and gives the proper procedures for correcting the problem.
4. If the symptom doesn't appear on the troubleshooting chart, or if the recommended repair doesn't work, consult your sales or service representative to arrange for on-site or factory service.

3.2. INTERPRETING FRONT PANEL ERROR MESSAGES

If the AT10 control circuit detects a hardware or wiring problem, it may display an error code on the front panel. The table starting on the next page lists the error codes, and the procedures to use to solve the problem.

WARNING:

High voltages appear at several points inside the battery charger. Use extreme caution when working inside the charger. Do not attempt to work inside the charger unless you are a qualified technician or electrician.

Disconnect and lock out all power from the battery charger before starting to remove or replace any components. Turn the ac power off at the distribution panel upstream from the battery charger. Disconnect the battery from the charger output terminals.

Error Code	Meaning	Repair Procedure
Er 1	Resistor R2 open or defective	Resistor R2 is installed at the back of the front panel, in the control circuit board input connector. R2 is measured by the control circuit on startup (or reset), and is used to determine some of the AT10 charger's parameters, such as the float voltage. If the AT10 finds that R2 is defective, it must be replaced. You must use a special tool, Molex No. 11-03-0038, to remove the old R2 from the connector. See section 3.6 for parts ordering information. When you have completed the repair, restart the charger according to section 2.
Er 2	Short circuit on output	You may get this error code if the battery is discharged to less than 6 volts. When the battery charges to greater than 6 volts, the error code disappears. Allow the charger to run for 24 hours and check the battery voltage again. If it has not increased to the normal voltage rating, consult the battery manufacturer for help. If the battery voltage is normal, then check the wiring at the dc output terminals for a short circuit. If the battery voltage is normal and all external wiring is OK, check the dc breaker on the charger. If it is tripped, try once to reset it. If it trips again immediately, there may be an internal short circuit in the charger. Check the internal wiring. If the charger is filtered, check the dc filter capacitors and the polarity diode. The AT10 normally recovers automatically from an **Er 2** condition. If you have shut down the charger for service, restart it according to section 2.
Er 3	High DC Voltage Shutdown	To restart the charger, turn the ac breaker off, then on. If the optional Primary Alarm Board is installed, check the Equalize voltage and High DC Voltage alarm settings. The alarm setting must be higher than the Equalize voltage setting. If you get another High DC Voltage shutdown after a few minutes of operation, there may be an internal component failure. See *Charger output not controllable* in the troubleshooting chart.

Error Code	Meaning	Repair Procedure
Er 4	Internal memory failure	Any parameters that you set, such as Float or Equalize voltage, are saved internally. The internal memory is tested on startup (or reset). If the memory test fails, **Er 4** appears on the front panel display. The error may also appear if the controller was trying to write to the memory during power-down. If an **Er 4** appears, try restarting the AT10 by turning the ac and dc breakers off, then on. If the charger restarts normally, you must reenter any changes you made to the factory settings (float voltage, etc.). If **Er 4** appears repeatedly, the internal memory has been damaged. You must replace the control circuit board. See section 3.6 for parts ordering information.
Er 5	Battery is connected in reverse polarity	This error code can appear only on startup, if the ac breaker is turned on before the dc breaker. Rewire the battery correctly and go back to the beginning of the startup procedure (see section 2.1).

Error Code	Meaning	Repair Procedure
Er 6	R4 or R14 is defective, or remote sense wiring failed, or temperature compensation probe failed	Locate R4 on the back of the front panel. Remove the resistor and measure its value with an Ohmmeter (see table 3-1 for the correct value). If the resistor is not within 1% of the specified value, it must be replaced. Locate R14 inside the enclosure, mounted on the EMI filter A9. Remove one end of the resistor and measure its value with an Ohmmeter (see table 3-1 for the correct value). If the resistor is not within 1% of the specified value, it must be replaced. If you are using remote sense wiring from the battery to the AT10, the wiring may have failed. The usual failure is an open circuit; a short circuit will usually be indicated by smoke or fire in the wiring. If you are using the optional temperature compensation probe, the probe or the wiring from the probe to the AT10 may have failed with an open or short circuit. In either case, troubleshoot the wiring and replace it if necessary. Measure the resistance of the temperature compensation probe; it should be between 2,000 and 50,000 Ohms. *Caution:* The AT10 charger shuts down if it detects either of these wiring failures. You should respond to this problem quickly to avoid discharging your battery. Wire an annunciator (buzzer, e.g.) to the summary alarm relay on the optional Primary Alarm Board to get a remote indication of a charger shutdown or any other charger problem. If you have a failure in remote sense wiring or in the optional temperature compensation probe, rewire the AT10 for local voltage sensing until you correct the problem (see sections 1.10 and 1.12). You can then use the AT10 to keep the battery charged. When you complete the repair, restart the charger as described in section 2.
Er 7	DC breaker open, or internal failure	If the dc breaker is open, open the ac breaker, then reclose the dc and ac breakers. If the dc breaker trips again, see the troubleshooting chart in section 3.4. If the dc breaker is closed, but you have an **Er 7** display, check your battery. If the battery is disconnected, and you then disconnect the load, the charger may shut down and display an **Er 7** code. Restart the charger according to section 2. If the battery and load are OK, see the troubleshooting chart in section 3.4 for help in locating the problem.

3.3. USING THE TROUBLESHOOTING CHART

WARNING:

High voltages appear at several points inside the battery charger. Use extreme caution when working inside the charger. Do not attempt to work inside the charger unless you are a qualified technician or electrician.

Disconnect and lock out all power from the battery charger before starting to remove or replace any components. Turn the ac power off at the distribution panel upstream from the battery charger. Disconnect the battery from the charger output terminals.

Before you try to use the troubleshooting chart, be sure that you have followed the steps in section 3.1.

The troubleshooting chart that begins on the next page is divided into three columns. To use the chart:

1. Make a list of the charger's condition, including the trouble symptoms.
2. Find the symptom(s) in the first column of the chart.
3. The middle column contains common causes for the problem you observe, in order of probability.
4. Follow the action described in the right-hand column to correct the problem and return the charger to normal service.

Determining the condition of the charger:

- Is the front panel **AC ON** indicator lit?
- What is the ac voltage at the input terminals (measured with an ac voltmeter)?
- What is the dc voltage at the output terminals (measured with a dc voltmeter)?
- Does the meter on the front panel display any voltage or current?
- Are any alarm indicators lit (if you have the Primary Alarm board)?
- Do the front panel status indicators work (Charge Mode, for example)?
- Can you change the charger to the Equalize mode and back to Float?
- Is the charger making any noise? Is it unusually loud?
- Is there any sign or smell of smoking or burning?

While using the chart, refer to the wiring diagrams and parts layout drawings in Appendix C. See section 3.5 for instructions on replacing components.

3.4. THE TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
AC breaker trips immediately	1. Shorted rectifier diode or SCR	1. Test by disconnecting wire #12 from the rectifier assembly. Measure resistance between the two top rectifier terminals (labeled "AC" on the wiring diagram); it should be at least 100,000 Ohms (check both polarities). Replace rectifier assembly if resistance is low in either direction.
	2. Defective wiring to T1 or to the rectifier H/S assembly	2. Check spacing of terminals; check wiring for signs of insulation damage, burns, etc. Repair as necessary.
	3. Defective transformer T1	3. Test by disconnecting wires from X1, X4, Y1 and Y2. If ac breaker still trips, replace T1.
AC breaker trips after a few minutes	1. Loose connection to breaker	1. Check and tighten connections as required.
	2. Wrong ac voltage, or T1 taps miswired	2. Be sure the T1 primary taps are wired correctly for your input voltage (see section 1.7).
	3. Open SCR	3. Use a clamp-on ammeter to measure the current in wire #12 or #11. If it less than 70% of the dc output current, one of the SCR's or diodes is defective. Replace the rectifier module.
	4. SCR not controllable	4. Disconnect wire #24 from terminal E3 of the rectifier assembly (near the left front of the enclosure). Restart the charger. If You are able to measure output current, one of the SCR's is defective. Replace the rectifier assembly.
DC breaker trips immediately	1. Battery connected with reverse polarity	1. Check and correct battery wiring if necessary.
	2. Defective rectifier bridge (if unfiltered charger)	2. Test by disconnecting wire #12 from the rectifier assembly. Measure resistance between the two top rectifier terminals (labeled "AC" on the wiring diagram); it should be at least 100,000 Ohms (check both polarities). Replace rectifier assembly if resistance is low in either direction.
	3. Defective diode CR4	3. Remove wire #41 from the front rectifier circuit board. Test CR4 with an Ohmmeter; it should be at least 100,000 Ohms in one polarity, and less than 1,000 Ohms in the other polarity. Replace CR4 if it is defective.
	4. Defective polarity diode (if filter assembly is installed)	4. Remove wire #15 from terminal E14 on the CR1 heat sink, just above inductor L1. Measure the resistance from the heat sink to the shunt on the rectifier control board at the left front of the charger (check both polarities). If the resistance is less than 1,000 Ohms in both directions, replace the filter assembly.
	5. Defective wiring	5. Check spacing of terminals; check wiring for signs of insulation damage, burns, etc. Repair as necessary.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
DC breaker trips after a few minutes	1. Loose connection to breaker	1. Check and tighten connections as required.
	2. Open SCR	2. Use a clamp-on ammeter to measure the current in wire #12 or #11. If it less than 70% of the dc output current, then one of the SCR's or diodes is defective. Replace the rectifier module.
	3. SCR not controllable	3. Disconnect wire #24 from terminal E3 of the rectifier assembly (near the left front of the enclosure). Restart the charger. If You are able to measure output current, one of the SCR's is defective. Replace the rectifier assembly.
	4. Defective control circuit board A1	4. If the front panel meter shows more than 110% of rated dc current, the control board may be defective. Disconnect wire #24 as above. If the output current goes to zero, replace the control board.
No output current, but ac and dc breakers are on; **AC ON** lamp is out	1. AC supply failure	1. If **AC ON** indicator is out, check feeder circuit breaker or fuse.
	2. Input fuse F1 is blown (480 Vac input only)	2. Remove F1 from its front panel fuseholder and check with an Ohmmeter or fuse tester. Replace if required. NOTE: If the new fuse blows, see the sections titled "AC breaker trips immediately" and "AC breaker trips after a few minutes" for further troubleshooting hints.
	3. Defective wiring	3. Check terminals and wiring between T1 and the rectifier assembly, inductor L1, dc filter (if present), the dc breaker, and the output terminals. Check wire #29 from T1-Y1 and wire #28 from T1-Y2 to the control circuit board connector J1. Repair as necessary.
	4. Defective transformer T1	4. Use an ac voltmeter to measure the ac voltage from T1-X1 to X4. It is normally 50% to 80% higher than the rated dc output voltage. If it is too low, check the wiring of the primary taps (see section 1.7). If it is zero, replace T1.
No output current, but ac and dc breakers are on; **AC ON** lamp is on	1. Battery is fully charged	1. This is normal operation in a system with little or no dc load. As long as the charger maintains Float voltage, it is operating normally.
	2. Float or Equalize voltage set too low	2. Check the Float and Equalize voltages and adjust them if necessary. Consult your battery manufacturer for the proper voltage settings.
	3. Wrong ac input voltage, or T1 taps miswired	3. Be sure the T1 primary taps are wired correctly for your input voltage (see section 1.7).
	4. Defective wiring	4. Check terminals and wiring between T1 and the rectifier assembly, inductor L1, dc filter (if present), the dc breaker, and the output terminals. Repair as necessary.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
	5. Defective rectifier bridge	5. Use an ac voltmeter to measure the voltage between terminals E3 and E4 of the rectifier circuit board nearest the front of the charger. If you measure about 1.0 Vrms, but there is no output current, replace the rectifier assembly.
	6. Defective control circuit board A1	6. If you do not measure any ac voltage in step 5 above, and the battery voltage is less than the Float voltage setting, replace the control circuit board.
	7. Defective transformer T1	7. Use an ac voltmeter to measure the ac voltage from T1-X1 to X4. It is normally 50% to 80% higher than the rated dc output voltage. If it is too low, check the wiring of the primary taps (see section 1.7). If it is zero, replace T1.
	8. Defective inductor L1 or L2	8. Disconnect the wiring from L1 and measure the resistance between the terminals. If it is an open circuit, replace L1. Repeat for L2 if the optional dc filter is installed.
	9. Defective CR2	9. Disconnect wire #52 from L1 to CR2, then check CR2 with an Ohmmeter (check both polarities). If CR2 is open, replace the filter assembly. This is a very rare occurrence.
	10. Defective dc breaker	10. Disconnect the battery, and connect a light dc load to the charger. Measure the dc voltage from the input terminal to the output terminal of the circuit breaker, with the breaker on. It is normally no more than 50 millivolts. If it is near the rated output voltage, replace the breaker.
Front panel is dead; ac and dc voltages are present at TB1	1. Control circuit board A1 is not connected	1. Make sure the connector at the top edge of the control circuit board is firmly seated.
	2. Defective control circuit board A1	2. If the **AC ON** indicator is lit, but the rest of the front panel is dead, replace the control circuit board.
	3. Defective wiring	3. Check the harness wiring to the control circuit board connector for signs of insulation damage, burns, etc. Be sure all wires are securely crimped in the connector.
Front panel dies during ac power failure; dc voltage is present at TB1	1. Defective power resistor R3	1. Use a dc voltmeter to measure the dc voltage from E17 on the I/O panel to TB1(-). It is normally 12 Vdc when the rated output voltage is at TB1(+) and TB1(-). Remove all power from the charger, and measure the resistance from TB1(+) and E17 (see the table in section 3.3 for the proper resistance value). If the resistance is not within 10% of the table value, replace R3.
	2. Defective wiring	2. Remove the enclosure shroud, and check the wiring to and from TB1 and the control circuit board for signs of insulation damage or burns. Repair any damaged wiring.
	3. Defective EMI filter A9	3. Remove the enclosure shroud. Check the EMI filter A9 by disconnecting the wiring and measuring the resistance from input to output terminals of the filter. The resistance should be near zero. Replace the filter if necessary.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
Charger output voltage too high, not controllable	1. Defective SCR	1. Disconnect wire #24 from terminal E3 of the rectifier assembly (near the left front of the enclosure). Restart the charger. If You are able to measure output current, one of the SCR's is defective. Replace the rectifier assembly.
	2. R4 or R14 is defective, or wrong value	2. Remove one end of R4 from TB5 (on the back of the front panel) and measure its resistance (see Table 3.1). If the resistance is not within 1% of the table value, replace R4. Repeat for R14, located behind the EMI filter, A9.
	3. Defective temperature compensation probe (optional)	3. Remove one of the probe leads from TB5 and measure its resistance. At 25 °C (77 °F) the resistance should be close to that of R4 (see the table in section 3.3). If it is not, replace the probe assembly.
	4. Defective control circuit board A1	4. If the front panel meter shows more than 110% of rated dc current, the control board may be defective. Disconnect wire #24 from terminal E3 of the rectifier assembly (near the left front of the enclosure). Restart the charger. If the output current goes to zero, replace the control board.
Output voltage does not agree with front panel meter	1. Temperature compensation probe is installed	1. If the optional temperature compensation probe is installed, the output voltage may be different from the selected float or equalize voltage. The difference in the voltages depends on the probe temperature. The front panel meter always displays the selected voltage.
	2. Circuit board or another component may have been replaced	2. Recalibrate meter. See section 2.3.7.
	3. R4 is defective, or wrong value	3. Remove one end of R4 from TB5 (on the back of the front panel) and measure its resistance (see Table 3.1). If the resistance is not within 1% of the table value, replace R4. Repeat for R14, located behind the EMI filter, A9.
	4. Defective control circuit board A1	4. Open the front panel, and press the reset button (S7) at the bottom right corner of the control circuit board. If the charger still has the wrong output voltage, replace the control circuit board.
Charger never reaches float (or equalize) voltage (within 1%)	1. Current limit set too low	1. Check the current limit setting: on the front panel, press and hold the UP arrow, and press the **EDIT/ENTER** key. The current limit value (in percent) appears in the meter display. If the current limit is less than 110%, adjust it to 110%. See section 2.3.5, Setting the Current Limit Value.
	2. Defective battery or dc load, or load is too great	2. Check each cell of the battery. If one or more cells is shorted, the charger may not be able to reach the Float voltage. You may have the same problem if the normal load current is more than the rated output current of the charger.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
	3. Wrong ac input voltage, or voltage too low, or T1 wired incorrectly	3. Be sure the T1 primary taps are wired correctly for your input voltage (see section 1.7). The actual ac input voltage must be at least 88% of the rated value for the charger to produce full output power.
	4. Defective rectifier bridge	4. Use a clamp-on ammeter to measure the current in wire #12 or #11. If it less than 70% of the dc output current, one of the SCR's or diodes is defective. Replace the rectifier module.
	5. Defective control circuit board A1	5. Open the front panel, and press the reset button (S7) at the bottom right corner of the control circuit board. If the charger output current is below the current limit value, but it still has the wrong output voltage, replace the control circuit board.
Input current too high	1. Wrong ac input voltage, or transformer T1 wired incorrectly	1. Be sure the T1 primary taps are wired correctly for your input voltage (see section 1.7). The actual ac input voltage must be at least 88% of the rated value for the charger to produce full output power.
	2. Defective rectifier bridge	2. Disconnect wire #24 from terminal E3 of the rectifier assembly (near the left front of the enclosure). Restart the charger. If You are able to measure output current, one of the SCR's is defective. Replace the rectifier assembly.
	3. Defective T1	3. Test by disconnecting wires from X1, X4, Y1 and Y2. If ac input current is still too high, replace T1.
Output ripple voltage too high	1. Charger is unfiltered	1. Verify by checking nameplate against the ordering code on page i. Order and install filter option if necessary.
	2. Battery is disconnected or defective	2. Be sure battery is connected. Inspect battery according to the manufacturer's instructions.
	3. Battery too small for charger rating	3. Output ripple is rated 30 mV maximum when battery Ampere-hours are 4 times the charger ampere rating.
	4. One or more defective filter capacitors, C1 or C2	4. Test with capacitance meter; replace as necessary.
Charger very noisy	1. Loose hardware or enclosure panel	1. Remove the enclosure shroud. Check and tighten all component mounting hardware. Replace the shroud, being sure all assembly hardware is secure.
	2. Defective rectifier bridge	2. Use a clamp-on ammeter to measure the ac current in wire #11 or #12 (connected between T1 and the rectifier assembly). If it less than 70% of the dc output current, one of the SCR's or diodes is defective. Replace the rectifier module.
Meter readings are erratic	1. Defective or disconnected battery	1. Turn off the charger. With a light dc load connected to the battery, be sure each cell reads the nominal cell voltage (2.0 V for lead-acid; 1.25 V for Ni-Cd). Restart the charger. Each cell should now read the nominal Float voltage (2.2 V for lead-acid; 1.35 V for Ni-Cd).

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
	2. Defective scaling resistor R4	2. Remove one end of R4 from TB5 (on the back of the front panel) and measure its resistance (see Table 3.1). If the resistance is not within 1% of the table value, replace R4.
	3. Defective control circuit board A1	3. If the output voltage is constant, replace the control circuit board.
Lamp test key doesn't work, or some lamps don't light	1. Control circuit board A1 is not secured to front panel	1. Open the front panel, and be sure that the control circuit board is securely mounted on the standoffs on the back of the panel. All indicators should extend about 1/8" through the front of the panel.
	2. Defective control circuit board A1	2. When you press the **LAMP TEST** key, if some but not all of the indicators light, or the digital meter does not display all 8's, replace the control circuit board.
One or more front panel keys don't work	1. Front panel is locked	1. Open the front panel, and be sure that jumper J4 on the main control board is in the **ENABLE** position.
	2. Control circuit board A1 is not secured to front panel	2. Open the front panel, and be sure that the control circuit board is firmly seated on the standoffs on the back of the panel. Front panel keys must operated freely.
	3. Defective control circuit board A1	3. Open the front panel, and press the reset button (S7) at the bottom right corner of the control circuit board. If some of the front panel keys still do not work, replace the control circuit board.
Two chargers are connected in parallel, but only one has output current	1. Check for normal operation of both chargers	1. The AT10 is not designed to share the load current when two or more chargers are connected in parallel, so it is normal for one of a pair to have no output current. You can check the operation of the "off" charger by increasing its Float voltage until it starts to deliver output current. When you have finished the test, be sure both chargers are set to the same Float and Equalize voltages.
These indications may appear if you have the optional Primary Alarm Board installed.		
HIGH DC VOLTAGE indicator is on	1. High DC Voltage alarm and Equalize voltage settings are mismatched	1. Be sure that the High DC Voltage alarm setting is higher than the Equalize voltage setting. See sections 2.3.2 and 2.3.4.
	2. Defective rectifier bridge	2. Disconnect wire #24 from terminal E3 of the rectifier assembly (near the left front of the enclosure). Restart the charger. If You are able to measure output current, one of the SCR's is defective. Replace the rectifier assembly.
	3. Primary alarm board A4 is not properly connected	3. Open the front panel. Be sure the alarm board is firmly seated against the control circuit board, and all edge connector pins are properly mated.
	4. Defective alarm board A4	4. If the output voltage is normal, and the front panel Meter Mode indicators work properly, replace the Primary Alarm board.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
	5. Defective control circuit board A1	5.Open the front panel, and press the reset button (**S7**) at the bottom right corner of the control circuit board. If the charger output voltage is normal, but the **HIGH DC VOLTAGE** indicator is still on, replace the control circuit board.
No alarm, but output voltage is above High DC Voltage setting	1. Output current is below 2%	1. Output current must be greater than 2% of rated current to produce a High DC Voltage alarm (see Parallel Operation in section 2.3.6).
	2. Defective alarm board A4	2. If the output voltage is above the alarm setting, and the front panel Meter Mode indicators work properly, replace the Primary Alarm board.
	3. Defective control circuit board A1	3. Open the front panel, and press the reset button (S7) at the bottom right corner of the control circuit board. If the charger output voltage is above the alarm setting, but the **HIGH DC VOLTAGE** indicator still doesn't light, replace the control circuit board.
LOW DC VOLTAGE indicator is on, but ac and dc breakers are closed; ac input voltage is normal; there is output current	1. Battery is discharged	1. After an ac power failure, or a battery discharge for any other reason, it may take several hours to recharge the battery. It is normal for the **LOW DC VOLTAGE** indicator to be on until the battery voltage is above the Low DC Alarm voltage.
	2. Low DC Voltage alarm and Float voltage settings are mismatched	2. Be sure that the Low DC Voltage alarm setting is lower than the Float voltage setting. See sections 2.3.2 and 2.3.4.
	3. Defective rectifier bridge	3. Use a clamp-on ammeter to measure the current in wire #11 or #12. If it less than 70% of the dc output current, one of the SCR's or diodes is defective. Replace the rectifier assembly.
	4. Primary alarm board A4 is not properly connected	4. Open the front panel. Be sure the alarm board is firmly seated against the control circuit board, and all edge connector pins are properly mated.
	5. Defective alarm board A4	5. If the output voltage is normal, and the front panel Meter Mode indicators work properly, replace the Primary Alarm board.
	6. Defective control circuit board A1	6. Open the front panel, and press the reset button (S7) at the bottom right corner of the control circuit board. If the charger output voltage is normal, but the **LOW DC VOLTAGE** indicator is still on, replace the control circuit board.
	7. Defective dc breaker	7. Disconnect the battery, and connect a light dc load to the charger. Measure the dc voltage from the input terminal to the output terminal of the circuit breaker, with the breaker on. It is normally no more than 50 millivolts. If it is near the rated output voltage, replace the breaker.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
DC OUTPUT FAILURE indicator is on, but ac and dc breakers are closed; ac input voltage is normal	1. Defective rectifier bridge	1. Use a clamp-on ammeter to measure the current in wire #12 or #11. If it is less than 70% of the dc output current, one of the SCR's or diodes is defective. Replace the rectifier module.
	2. Primary alarm board A4 is not properly connected	2. Open the front panel. Be sure the alarm board is firmly seated against the control circuit board, and all edge connector pins are properly mated.
	3. Defective alarm board A4	3. If the output voltage and current are normal, and the front panel Charger Mode indicators work properly, replace the Primary Alarm board.
	4. Defective control circuit board A1	4. Open the front panel, and press the reset button (**S7**) at the bottom right corner of the control circuit board. If the charger output voltage and current are normal, but the **DC OUTPUT FAILURE** indicator is still on, replace the control circuit board.
	5. Defective transformer T1	5. Use an ac voltmeter to measure the ac voltage from T1-X1 to X4. It is normally 50% to 80% higher than the rated dc output voltage. If it is too low, check the wiring of the primary taps (see section 1.7). If it is zero, replace T1.
	6. Defective dc breaker	6. Disconnect the battery, and connect a light dc load to the charger. Measure the dc voltage from the input terminal to the output terminal of the circuit breaker, with the breaker on. It is normally no more than 50 millivolts. If it is near the rated output voltage, replace the breaker.
AC INPUT FAILURE indicator is on	1. AC power failure	1. If the ac input power fails, the front panel **AC ON** indicator goes out, and the **AC INPUT FAILURE** indicator goes on.
	2. Upstream feed breaker/fuse is tripped	2. Be sure the front panel ac circuit breaker is closed. Measure the ac voltage at TB1-L1 and L2. If it is zero, check upstream distribution breakers and fuses.
	3. Defective wiring	3. Measure ac voltage at T1-H1 and T1-H5. It should be the same as the ac supply voltage.
	4. Primary alarm board A4 is not properly connected	4. Open the front panel. Be sure the alarm board is firmly seated against the control circuit board, and all edge connector pins are properly mated.
	5. Defective alarm board A4	5. If the **AC ON** indicator is on, and the front panel Meter Mode indicators work properly, replace the Primary Alarm board.
	6. Defective control circuit board A1	6. Open the front panel, and press the reset button (S7) at the bottom right corner of the control circuit board. If the **AC ON** indicator is on, but the **AC INPUT FAILURE** indicator is still on, replace the control circuit board.
POS GND or **NEG GND** indicator is on	1. Ground fault on external dc bus	1. Disconnect the charger from the battery and dc bus, and check the battery and dc bus for a ground fault.
	2. Primary alarm board A4 is not properly connected	2. Open the front panel. Be sure the alarm board is firmly seated against the control circuit board, and all edge connector pins are properly mated.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
	3. Alarm board needs calibration	3. Calibrate the ground detection sensitivity. See section 2.3.4.
	4. Defective wiring	4. Disconnect the charger from the battery and dc bus. Turn the charger on, and measure the voltage from **TB1(+)** to chassis, and from **TB1(-)** to chassis. The voltage readings should be equal, each approximately half of the total output voltage. If there is more than a 10% imbalance, turn off the charger, and inspect all wiring from **TB1** to **CB2**, the optional dc filter, **L1**, and the rectifier bridge. Look for evidence of insulation damage, insufficient spacing between terminals and chassis, or wires run too close to metal edges.
	5. Defective alarm board A4	5. If the **POS GND** or **NEG GND** indicator is on, and the front panel Charger Mode and Equalize Method indicators work properly, replace the Primary Alarm board.
	6. Defective control circuit board A1	6. Open the front panel, and press the reset button (S7) at the bottom right corner of the control circuit board. If you are sure there is no ground fault on the external bus or within the charger, but the **POS GND** or **NEG GND** indicator is still on, replace the control circuit board.
Summary alarm relay is in alarm mode, but no front panel alarm indicator is on	1. Primary alarm board A4 is not properly connected	1. Open the front panel. Be sure the alarm board is firmly seated against the control circuit board, and all edge connector pins are properly mated.
	2. Defective alarm board A4	2. If the relay is in alarm condition, but no other alarm indicator is on, and the front panel Equalize Method indicators work properly, replace the Primary Alarm board.
	3. Defective control circuit board A1	3. Open the front panel, and press the reset button (**S7**) at the bottom right corner of the control circuit board. If the relay remains in alarm mode, but no other alarm is on, replace the control circuit board.

3.5. REPLACING DEFECTIVE COMPONENTS

WARNING:

High voltages appear at several points inside the battery charger. Use extreme caution when working inside the charger. Do not attempt to work inside the charger unless you are a qualified technician or electrician.

Disconnect and lock out all power from the battery charger before starting to remove or replace any components. Turn the ac power off at the distribution panel upstream from the battery charger. Disconnect the battery from the charger output terminals.

Removing the safety shield

Some of the repair procedures described below require you to remove the clear plastic safety shield over the I/O (input/output) panel inside the front panel. You remove the shield by taking off the wing nuts on the front. Don't lay the shield on the top of the charger; the top vents are needed for cooling.

CAUTION: AC and dc voltages are present at the I/O panel terminals.

Removing the enclosure shroud

You may need to remove the enclosure shroud in order to make some internal measurements, and to replace or repair some components. ***Remove all power from the charger.*** Remove the eleven screws that hold the shroud on the rear and bottom of the enclosure, then the two screws on the left side that hold the rectifier heat sink assembly. Support the front panel and lift the shroud straight up to remove it. Be sure to save the plastic washers from the door hinge.

The heat sink assembly is supported from the rear panel. Avoid putting any mechanical stress on the heat sink.

Replacing the enclosure shroud

Lower the shroud onto the enclosure base. Install and tighten the eleven screws that hold the shroud on the rear and bottom of the base before you install the two screws that support the heat sink assembly on the left side wall. Remember to reinstall the plastic washers on the door hinge.

Note: Refer to the drawings in Appendix C while performing the following procedures.

Replacing the control circuit board A1

CAUTION: A1 is sensitive to damage from static discharges. Leave the circuit board in its anti-static bag until you are ready to install it. Ground yourself before handling the board by touching the ground stud on the back of the door. Handle the board only by the edges.

Turn off all power to the charger. Disconnect the battery from the output terminals. If the optional Primary Alarm board is installed, remove it first. Remove the harness plug from the upper left edge of the control circuit board, and unplug wire #30 from the quick-connect terminal near the upper left corner of the board.

The board is mounted on four plastic standoffs. Compress the tab on each standoff, and pull the board toward you until it clears all four standoffs. Put the replacement board in place with the same orientation, and push it onto the standoffs. Be sure that the board is fully seated on the standoffs. Replace wire #30 on the quick-connect terminal, and connect the harness plug to the board at the top edge. See section 2.1 for the steps to restart the charger.

If your charger parameters (float voltage, etc.) are different from the factory preset values, you should program in the new values now. See section 2.3. You should also recalibrate the dc voltmeter according to section 2.3.7.

Replacing the rectifier heat sink assembly A6

Deenergize and lock out all ac and dc voltage sources to the AT10. Check with a voltmeter before proceeding. This includes remote sense wires if they were installed. Remove the 2 screws from the middle of the exterior left side of the shroud (above and below the nameplate). Working through the door, firmly hold the front edge of the heat sink and pull straight out, so that the heat sink plastic anchors snap out of the holes in the rear panel. Pull the rectifier assembly toward you, removing the attached wires as you pull it out of the enclosure. Disconnect only those wires connected to the rectifier assembly that originate elsewhere in the AT10.

Hold the replacement rectifier assembly in front of the AT10 (in the same orientation as the old), and reconnect all wires you removed from the old assembly as you insert it into the enclosure. To ensure correct replacement, see the wiring diagrams in Appendix C. When you are done, check your work to be sure all wires are connected to the proper terminals, and all lugs are fully seated. If any lug does not fit snugly, disconnect it and carefully tighten the ears of the lug using long-nosed pliers. Reconnect the lug.

Rotate the rectifier assembly into position in the enclosure. Line up the plastic anchors with the mounting holes on the back wall of the charger and push the assembly firmly to seat the anchors fully into the rear panel. Replace the 2 screws on the left side of the shroud.

Replacing the ac input or dc output circuit breaker CB1, CB2

Deenergize and lock out all ac and dc voltage sources to the AT10. Check with a voltmeter before proceeding. This includes remote sense wires if they were installed. Remove the two circuit breaker mounting screws on the front panel, and carefully rotate the circuit breaker upward and pull it out of the charger. Remove the wires from the terminals, one at a time, and transfer the wires to the terminals of the replacement breaker. *Be sure the terminal screws are tight*. Install the replacement breaker into the front panel, rotating it downward into place. Install the two mounting screws.

Replacing the dc filter assembly A7

The dc filter assembly consists of a diode heat sink, inductor L2, and one or two capacitors installed on a single bracket.

Turn off all power to the charger. Disconnect the battery from the output terminals. Remove the safety shield.

Find the flying lead from the inductor L2 (wire #50) and disconnect the other end from the center terminal of inductor L1 (at the upper right corner of the rear panel). Disconnect wire #15 from the quick-connect terminal at the top center of the diode heat sink, and remove wire #54 from terminal E7 on the front circuit board on the rectifier assembly. Carefully note which terminal the wire is connected to. Remove the four screws at the top of the dc filter bracket. The bracket and the inductor will both fall forward, away from the rear panel.

Lift the filter bracket up about 1/4 inch to release it from the clips at the bottom of the bracket. Swing the filter assembly outward to the left, rotating it so that the heat sink comes out first, and the filter capacitor(s) last.

Install the replacement filter assembly by inserting the capacitor end first, and rotating the assembly inward so that the heat sink is last to go in. Push the bottom edge of the bracket into the clips in the rear panel, and install the four screws at the top of the bracket.

Connect wire #15 to the quick-connect terminal at the top center of the diode heat sink. Route the flying lead from the inductor L2 (wire #50) and connect it to the center terminal ("2") of the inductor L1. Reconnect wire #54 to terminal E7 of the front circuit board on the rectifier assembly. Replace the shroud and the safety shield.

Replacing the main transformer T1

Deenergize and lock out all ac and dc voltage sources to the AT10. Check with a voltmeter before proceeding. This includes remote sense wires if they were installed. Remove the enclosure shroud and the safety shield. Disconnect the harness wires #28 and #29 from the upper row of transformer terminals. Disconnect wires #11 and #12 from the top of the rectifier heat sink. Disconnect harness wires #3 and #4 from the lower row of terminals; leave both jumpers in place on the lower row.

Remove the four screws or nuts that secure the transformer to the rear panel. Support the transformer by the top of the core and lift it up to get the bottom bracket off the rear panel. Remove the transformer from the charger.

Check the jumpers on the bottom row of terminals of the replacement transformer. Make sure they are connected to the same terminals as the jumpers on the transformer you just removed from the charger. For more information, see section 1.7, Changing Transformer Taps.

Hold the replacement transformer with the terminals labeled H1 through H5 at the bottom, facing you. Place the transformer against the rear panel, and slide the bottom of the transformer bracket into the slots on the rear panel. Install the four screws or nuts onto the mounting bracket of the transformer. Rewire the transformer, following the steps above in reverse. Refer to section 1.7, and verify that the transformer is properly connected for your input voltage.

Replacing the ac surge suppressor VR2

Turn off all power to the charger. Disconnect the battery from the output terminals. Remove the safety shield. Remove the hardware from the input terminal L1, and remove the lead of the ac surge suppressor. Install one lead of the replacement surge suppressor onto the L1 terminal. Replace the other wires and the hardware. Repeat for the L2 terminal. Tighten all hardware.

Note: The surge suppressor is not polarized.

Replacing the power resistor R3

Turn off all power to the charger. Disconnect the battery from the output terminals. Remove the safety shield.

Locate the power resistor R3. On 130 Vdc chargers, it is mounted on the bracket behind the I/O panel. On all other chargers, it is installed just to the right of the I/O panel. Remove the lead of R3 from the terminal of the EMI filter A9, and replace it with the corresponding lead of the replacement power resistor. Then remove the other lead of R3 from terminal E17 on the I/O panel, and replace it with the remaining lead of the replacement power resistor. Tighten all hardware.

In 12 Vdc through 48 Vdc chargers, align the new R3 next to the I/O panel so that the leads are properly spaced. In 130 Vdc chargers, remove the two screws that mount the old resistor, and put the new resistor in its place. Tighten all hardware.

Replacing the scaling resistor R4

Locate the scaling resistor R4 on TB5 on the back of the front panel, just above the control circuit board. The resistor (R4 is the one on the left) is mounted on two quick-connect terminals. Remove the resistor by grasping the terminals by the plastic insulation, and pulling out and downward. Install the replacement resistor by pushing the terminals firmly onto the quick-connect blades on the terminal block.

Replacing the scaling resistor R14

Turn off all power to the charger. Disconnect the battery from the output terminals. Remove the safety shield.

The scaling resistor R14 is connected to one terminal of the EMI filter, behind the I/O panel. The other resistor lead is soldered to wire #20.

Remove the insulating sleeving from the soldered joint to wire #20 (you may have to remove a harness tie) and cut the resistor lead near the solder joint. Disconnect the old resistor from the filter and discard it.

Using a soldering iron no larger than 35 Watts, solder the bare lead of the new R14 to wire #20. Insulate the joint with plastic electrical tape. Connect the other end of R14 to the EMI filter.

Replacing the resistor R6

Locate the resistor R6 on TB5 on the back of the front panel, just above the control circuit board. The resistor (R6 is the one on the right) is mounted on two quick-connect terminals. Remove the resistor by grasping the terminals by the plastic insulation, and pulling out and downward. Install the replacement resistor by pushing the terminals firmly onto the quick-connect blades on the terminal block.

Replacing the EMI filter assembly A9

Deenergize and lock out all ac and dc voltage sources to the AT10. Check with a voltmeter before proceeding. This includes remote sense wires if they were installed. Remove the enclosure shroud and the safety shield. Locate the EMI filter A9 behind and to the right of the I/O panel.

Remove the wires from the filter terminals one at a time, placing the wires on the corresponding terminals of the replacement EMI filter.

Note: The terminals are labeled "line" and "load." Be sure to connect the wires to the correct terminals.

Remove the hardware from the old EMI filter and remove the filter. Mount the replacement filter, using the same orientation as the old filter. Be sure that the terminals and wiring to the filter are not stressed. Tighten all hardware.

Replacing the dc surge suppressor VR1

Turn off all power to the charger. Disconnect the battery from the output terminals. Remove the safety shield. Remove the hardware from the output terminal TB1(+), and remove the lead of the dc surge suppressor. Install one lead of the replacement surge suppressor. Replace the other wires and the hardware. Repeat for the output terminal TB1(-). Tighten all hardware.

Note: The surge suppressor is not polarized.

3.6. ORDERING REPLACEMENT PARTS

To order replacement parts, please provide the following information for each component:

- Circuit symbol from the schematic diagram (see Appendix)
- Factory part number and description, from the table below
- Model number and serial number of your battery charger
- Quantity required

Call your sales representative to place an order for spare parts or replacement parts.

Table 3-1: REPLACEMENT PARTS

Symbol	Description	Factory Part Number				Rec. Spares
		12 Vdc	24 Vdc	48 Vdc	130 Vdc	
A1	Control circuit board assembly	EJ1243-01				Y
A4	Primary alarm circuit board assembly	EJ1243-02				Y
A5	Auxiliary Relay circuit board assembly	EJ1243-03				Y
A6	Rectifier/Heat Sink assembly	EJ1243-00				Y
A7	DC Filter assembly	See Table 3-2				
A8	Battery Eliminator Filter assembly (requires filtered charger)	EJ1155-00			EJ1155-01	
A9	EMI Filter assembly	PM0021-00				
A10	Temperature Compensation Probe assembly	See Appendix B, Table 2				
C1	Filter capacitor	RP0019-09			RP0019-08	Y
C2	Filter capacitor, battery eliminator	RP0019-09			RP0019-08	Y
C4	EMI filter capacitor	RP0043-20				
C5	EMI filter capacitor	RP0043-20				
CB1	AC circuit breaker – standard, 120/208/240 V	See Table 3-3				
CB1	AC circuit breaker – Med. AIC, 120/208/240 V	See Table 3-4				
CB1	AC circuit breaker – High AIC, 120/208/240 V	See Table 3-5				
CB1	AC circuit breaker – Med. AIC, 480 V	RE0171-00				
CB1	AC circuit breaker – High AIC, 480 V	RE0043-00				

Symbol	Description	Factory Part Number				Rec. Spares
		12 Vdc	24 Vdc	48 Vdc	130 Vdc	
CB2	DC circuit breaker – standard	See Table 3-6				
CB2	DC circuit breaker – Medium AIC	See Table 3-7				
CB2	DC circuit breaker – High AIC	See Table 3-8				
CR1	Polarity diode	EJ1243-04				Y
CR2	Blocking diode	EJ1243-05				
F1	480 VAC Input Fuse	See Table 3-14				Y
L1	Main Inductor	See Table 3-9				
L2	Filter Inductor	See Table 3-13				
P4	Jumper for front panel lockout feature on A1	RC0100-00				
P5	Jumper for disabling Ground Detection circuit	RC0100-00				
P7	Jumper for voltage selection on Auxiliary Relay circuit board	RC0100-00				
R2	Rating resistor	See Table 3-10				
R3	Power resistor	EJ1127-00	EJ1127-01	EJ1127-02	EJ1127-03	Y
R4	Scaling resistor, positive side	EJ1134-00 3160Ω	EJ1134-01 6980Ω	EJ1134-02 14.0KΩ	EJ1134-03 38.3KΩ	
R6	Crowbar resistor	EJ1135-00	EJ1135-01	EJ1135-02	EJ1135-03	
R9	Bleed resistor	EJ1137-00	EJ1137-00	EJ1137-01	EJ1137-02	
R14	Scaling resistor, negative side	EJ1222-00 3160Ω	EJ1222-01 6980Ω	EJ1222-02 14.0KΩ	EJ1222-03 38.3KΩ	
T1	Main transformer – 120/208/240 Vac	See Table 3-11				
T1	Main transformer – 480 Vac	See Table 3-12				
TB1	Input/output terminals: ¼" studs with box lug for 14 – 6 AWG	RC0056-04				
TB6	Terminal block for Medium and High AIC breakers	Terminal section RC0014-00 (8 req'd) End section Rc0014-01 (1 req'd)				
VR1	Output Surge Suppressor	EJ1132-01				Y
VR2	Input Surge Suppressor – 120/208/240 Vac	EJ1132-01				Y
VR2	Input Surge Suppressor – 480 Vac	EJ1132-02				Y
VR3	Input Lightning Arrestor	EJ1074-00				

Table 3-2: DC FILTER ASSEMBLIES

Current Rating	12 Vdc	24 Vdc	48 Vdc	130 Vdc
6A	EJ1072-00	EJ1072-00	EJ1072-02	EJ1072-03
12A	EJ1072-00	EJ1072-00	EJ1072-02	EJ1072-06
16A	EJ1072-01	EJ1072-01	EJ1072-07	EJ1072-04
20A	EJ1072-01	EJ1072-01	EJ1072-07	EJ1072-04
25A	EJ1072-01	EJ1072-01	EJ1072-07	EJ1072-05

Table 3-3: STANDARD AC CIRCUIT BREAKERS - CB1/240V

Current Rating	12 Vdc	24 Vdc	48 Vdc	130 Vdc
6A	RE0159-11	RE0159-11	RE0159-11	RE0159-13
12A	RE0159-11	RE0159-11	RE0159-13	RE0159-16
16A	RE0159-11	RE0159-12	RE0159-13	RE0159-19
20A	RE0159-11	RE0159-12	RE0159-14	RE0159-20
25A	RE0159-11	RE0159-12	RE0159-15	RE0159-20

Table 3-4: MEDIUM AMPERE INTERRUPTING CAPACITY AC CIRCUIT BREAKERS - CB1/240V

Current Rating	12 Vdc	24 Vdc	48 Vdc	130 Vdc
6A	RE0171-00	RE0171-00	RE0171-00	RE0171-01
12A	RE0171-00	RE0171-00	RE0171-01	RE0171-04
16A	RE0171-00	RE0171-00	RE0171-01	RE0171-07
20A	RE0171-00	RE0171-00	RE0171-02	RE0171-08
25A	RE0171-00	RE0171-00	RE0171-03	RE0171-08

Table 3-5: HIGH AMPERE INTERRUPTING CAPACITY AC CIRCUIT BREAKERS - CB1/240V

Current Rating	12 Vdc	24 Vdc	48 Vdc	130 Vdc
6A	RE0043-00	RE0043-00	RE0043-00	RE0043-01
12A	RE0043-00	RE0043-00	RE0043-01	RE0043-04
16A	RE0043-00	RE0043-00	RE0043-01	RE0043-07
20A	RE0043-00	RE0043-00	RE0043-02	RE0043-08
25A	RE0043-00	RE0043-00	RE0043-03	RE0043-08

Table 3-6: STANDARD DC CIRCUIT BREAKERS - CB2

Current Rating	12 Vdc	24 Vdc	48 Vdc	130 Vdc
6A	RE0159-01	RE0159-01	RE0159-01	RE0159-12
12A	RE0159-02	RE0159-02	RE0159-02	RE0159-13
16A	RE0159-03	RE0159-03	RE0159-03	RE0159-14
20A	RE0159-04	RE0159-04	RE0159-04	RE0159-15
25A	RE0159-06	RE0159-06	RE0159-06	RE0159-17

Table 3-7: MEDIUM AMPERE INTERRUPTING CAPACITY DC CIRCUIT BREAKERS - CB2

Current Rating	12 Vdc	24 Vdc	48 Vdc	130 Vdc
6A	RE0171-00	RE0171-00	RE0171-00	RE0171-00
12A	RE0171-01	RE0171-01	RE0171-01	RE0171-01
16A	RE0171-02	RE0171-02	RE0171-02	RE0171-02
20A	RE0171-03	RE0171-03	RE0171-03	RE0171-03
25A	RE0171-04	RE0171-04	RE0171-04	RE0171-04

Table 3-8: HIGH AMPERE INTERRUPTING CAPACITY DC CIRCUIT BREAKERS - CB2

Current Rating	12 Vdc	24 Vdc	48 Vdc	130 Vdc
6A	RE0043-00	RE0043-00	RE0043-00	RE0043-00
12A	RE0043-01	RE0043-01	RE0043-01	RE0043-01
16A	RE0043-02	RE0043-02	RE0043-02	RE0043-02
20A	RE0043-03	RE0043-03	RE0043-03	RE0043-03
25A	RE0043-04	RE0043-04	RE0043-04	RE0043-04

Table 3-9: MAIN INDUCTOR - L1

Current Rating	12 Vdc	24 Vdc	48 Vdc	130 Vdc
6A	AP0928-00	AP0928-00	AP0928-00	AP1122-00
12A	AP0928-00	AP0928-00	AP0928-00	AP0930-00
16A	AP0929-00	AP0929-00	AP0929-00	AP0931-00
20A	AP0929-00	AP0929-00	AP0929-00	AP0931-00
25A	AP0929-00	AP0929-00	AP0929-00	AP0931-00

Table 3-10: RATING RESISTOR - R2

Current Rating	12 Vdc	24 Vdc	48 Vdc	130 Vdc
6A	EJ1133-00 34.8 KΩ	EJ1133-05 13.0 KΩ	EJ1133-10 5.11 KΩ	EJ1133-15 1.50 KΩ
12A	EJ1133-01 40.2 KΩ	EJ1133-06 15.4 KΩ	EJ1133-11 6.19 KΩ	EJ1133-16 2.21 KΩ
16A	EJ1133-02 53.6 KΩ	EJ1133-07 19.6 KΩ	EJ1133-12 7.50 KΩ	EJ1133-17 2.74 KΩ
20A	EJ1133-03 78.7 KΩ	EJ1133-08 23.7 KΩ	EJ1133-13 9.09 KΩ	EJ1133-18 3.57 KΩ
25A	EJ1133-04 118 KΩ	EJ1133-09 29.4 KΩ	EJ1133-14 11.0 KΩ	EJ1133-19 4.32 KΩ
Connector terminal extraction tool	Molex P/N 11-03-0038			

Table 3-11: MAIN TRANSFORMER, 120/208/240 VAC - T1

Current Rating	12 Vdc	24 Vdc	48 Vdc	130 Vdc
6A	AA0718-00	AA0719-00	AB2023-00	AB1868-00
12A	AA0718-00	AA0719-00	AB2023-00	AB1857-00
16A	AA0720-00	AB1855-00	AB1856-00	AB1858-00
20A	AA0720-00	AB1855-00	AB1856-00	AB1858-00
25A	AA0720-00	AB1855-00	AB1856-00	AB1858-00

Table 3-12: MAIN TRANSFORMER, 480 VAC - T1

Current Rating	12 Vdc	24 Vdc	48 Vdc	130 Vdc
6A	AA0733-00	AA0734-00	AB2038-00	AB2039-00
12A	AA0733-00	AA0734-00	AB2038-00	AB2032-00
16A	AA0735-00	AB2035-00	AB2036-00	AB2037-00
20A	AA0735-00	AB2035-00	AB2036-00	AB2037-00
25A	AA0735-00	AB2035-00	AB2036-00	AB2037-00

Table 3-13: FILTER INDUCTOR - L2

Current Rating	12 Vdc	24 Vdc	48 Vdc	130 Vdc
6A	AP0928-00	AP0928-00	AP0928-00	AP1081-00
12A	AP0928-00	AP0928-00	AP0928-00	AP0928-00
16A	AP0927-00	AP0927-00	AP0926-00	AP0926-00
20A	AP0927-00	AP0927-00	AP0926-00	AP0926-00
25A	AP0927-00	AP0927-00	AP0926-00	AP0926-00

Table 3-14: 480 VAC INPUT FUSE - F1

Current Rating	12 Vdc	24 Vdc	48 Vdc	130 Vdc
6A	RE0209-09	RE0209-11	RE0209-16	RE0209-21
12A	RE0209-11	RE0209-16	RE0209-21	RE0209-28
16A	RE0209-16	RE0209-21	RE0209-28	RE0209-31
20A	RE0209-16	RE0209-21	RE0209-28	RE0209-33
25A	RE0209-16	RE0209-21	RE0209-28	RE0209-33

APPENDIX A

SPECIFICATIONS

All specifications apply at 25 °C, 120 Vac, nominal Float voltage except as noted

Specification	Conditions	12 Vdc	24 Vdc	48 Vdc	130 Vdc
Output voltage regulation	Vac +10%, -12% 0 to 100% load Temp. 0 - 50 °C Freq. 60 ± 3 Hz	± 0.25%			
Transient response	20-100% load change, with battery connected	Output voltage change ± 4% maximum Recovery to ± 2.0% in 200 ms Recovery to ± 0.5% in 500 ms			
Efficiency	12 Adc rating, full load, %	67.00	72.00	78.00	85.00
	25 Adc rating, full load, %	73.00	77.00	85.00	91.00
Output ripple voltage (per NEMA PE5-1983)	Unfiltered, with battery	2% (typ) at battery terminals			
	Filtered, with battery	30 mV rms (max) at battery terminals			
	Filtered, without battery	1% rms (typ)			
	With battery eliminator option (without battery)	30 mV			100 mV
Current limit	Adjustable	50 - 110 % of rated output current			
Soft start	0 to 100% load	4 seconds			
Voltage adjustment ranges	Float	11.5-14.5	23.0-29.5	46-57	115-140
	Equalize	12-15.5	24-31	48-61	124-143
	High DC Voltage alarm	12-19	24-38	48-76	120-175
	Low DC Voltage alarm	7-12	15-24	30-48	80-120
Voltmeter range, Vdc		0 - 21	0 - 42	0 - 75	0 - 195
Ammeter range, Adc	6, 12 Adc ratings	17.6 A			
Ammeter range, Adc	16, 20, 25 Adc ratings	44.0 A			
Surge withstand capability	Test per ANSI C37.90.1-1989	No erroneous outputs			
Reverse current from battery	AC input power failure	90 mA maximum			
Audible noise	Average for 4 sides, 5 feet from charger	Less than 62 dB(A)			
Cooling		Natural convection			
Ambient temperature	Operating	0 - 50 °C (32 - 122 °F)			
Elevation		1000 M (3000 ft) without derating			
Relative humidity		0 to 95% non-condensing			
Alarm relay contact rating	120 Vac/125 Vdc	0.5 A resistive			

FIELD INSTALLABLE ACCESSORIES AND OPTIONS

All accessories/options listed below are available for field installation. Kits contain all parts and hardware with detailed installation instructions.

Description	Kit Part Number
Primary Alarm Board	EI0212-00
Auxiliary Relay Board for standard circuit breakers (requires Primary Alarm Board)	EI0213-00
Auxiliary Relay Board for medium/high AIC circuit breakers (requires Primary Alarm Board)	EI0213-01
Relay Rack Mounting Kit	EI0193-00
Floor Mounting Kit	EI0192-00
Temperature Compensation Assembly	See table below
Lightning Arrestor	EJ1074-00
Ground Bus with (1) box lug for 14 - 2 AWG	EI0195-00
Drip Shield	EI0191-00
Standard filtering (30 mV with battery)	See table 3-2
Battery Eliminator Filtering	See table 3-1
Cabinet Heaters	EJ1223-00
NEMA 4/12/13 Enclosure	EI0214-00
Padlock for door	EI0215-00

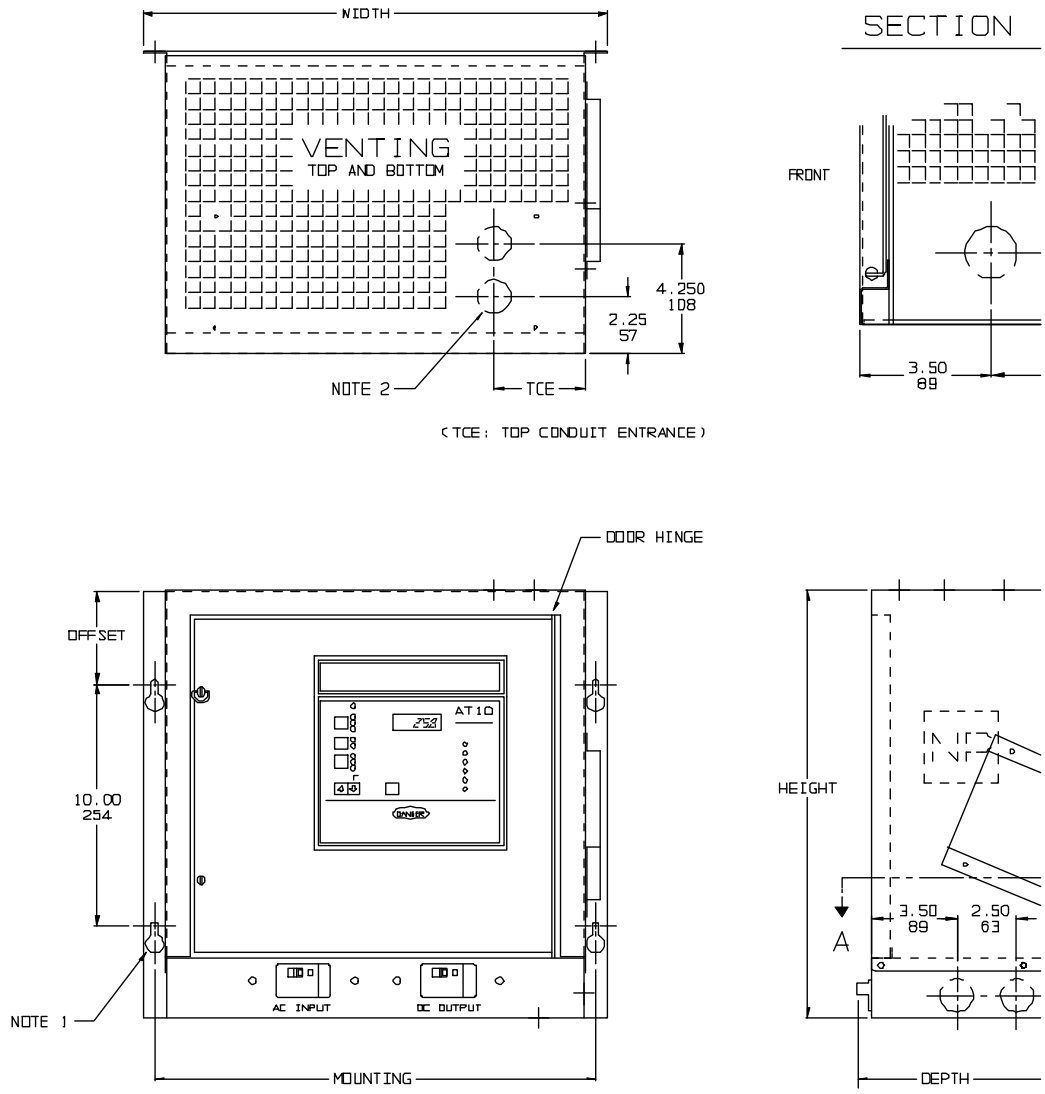
Temperature Compensation Assembly

Cell Type	Output Voltage, Vdc			
	12	24	48	130
Lead acid	EJ1136-00	EJ1136-01	EJ1136-02	EJ1136-03
Nickel-cadmium	EJ1136-05	EJ1136-06	EJ1136-07	EJ1136-08

The temperature compensation assembly is supplied with a standard 25' interconnection cable. If you need a longer cable, order it from the table below, in addition to the Temperature Compensation Assembly above.
Use a single cable assembly. Do not try to splice cables together to increase the length.

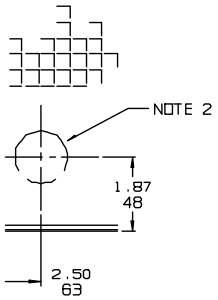
Cable Assemblies for Temperature Compensation Probe

Length, feet	Part Number
25	EJ1224-00
50	EJ1224-01
100	EJ1224-02
200	EJ1224-03



OUTLINE;
AT10 BATTERY CHARGER

A - A



RIGHT SIDE

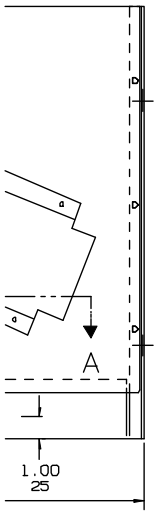
ENCLOSURE TYPE AND WEIGHT TABLE

OUTPUT VOLTAGE

OUTPUT CURRENT	12	24	48	130
6	586 35.00 15.91	586 50.00 22.73	586 65.00 29.55	586 70.00 31.82
12	586 50.00 22.73	586 55.00 25.00	586 75.00 34.09	594 130.0 59.09
16	586 65.00 29.55	586 90.00 40.91	594 95.00 43.18	594 180.0 81.82
20	586 70.00 31.82	586 90.00 40.91	594 100.0 45.45	594 185.0 84.09
25	586 75.00 34.09	586 95.00 43.18	594 105.0 47.73	594 195.0 88.64

5XX: ENCLOSURE TYPE
LBS. WEIGHT IN POUNDS
KGS: WEIGHT IN KILOGRAMS

(FOR SHIPPING WEIGHT ADD 20 LBS OR 9.0 KGS TO THE ABOVE TABLE WEIGHT)



DIMENSIONS

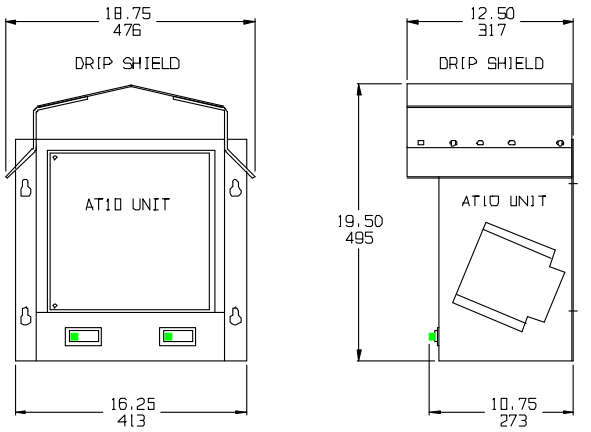
ENCLOSURE	586	594
HEIGHT	15.50 394	17.75 451
WIDTH	16.25 413	19.50 495
DEPTH	10.75 273	13.25 336
MOUNTING	15.00 381	18.25 464
OFFSET	2.62 66	3.82 97
TCE	2.00 50	3.75 95

DUAL DIMENSIONS IN / MM

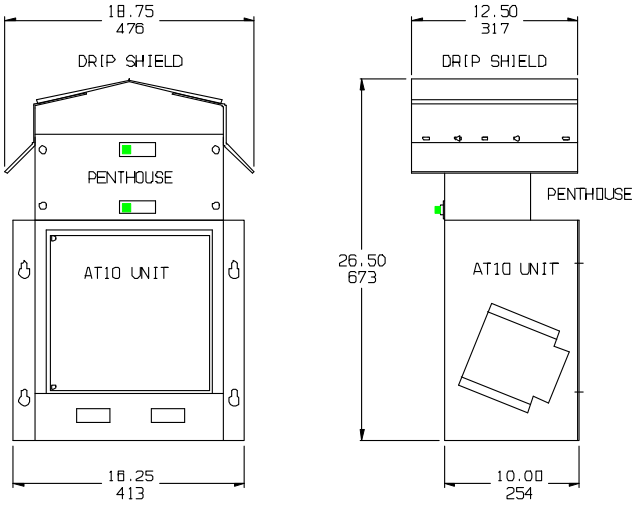
NOTES:

1. WALL MOUNTING HOLES ARE KEY-SLOT TYPE FOR A .25 DIA. FASTENER WITH SCREW HEAD DIA. NO LARGER THAN .625
2. 1" CONDUIT KNOCKOUTS PROVIDED FOR ENTRY AND EXIT. 6 PLCS (2 TOP, 2 BOTTOM AND 2 R.SIDE)

SMALL ENCLOSURE 586 WITHOUT PENTHOUSE

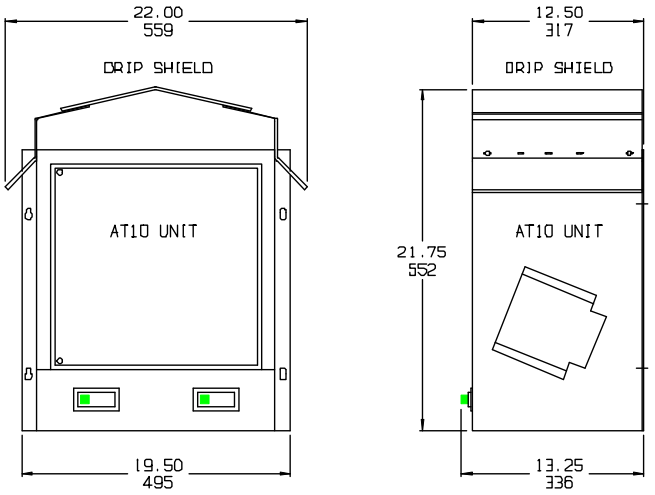


SMALL ENCLOSURE 586 WITH PENTHOUSE

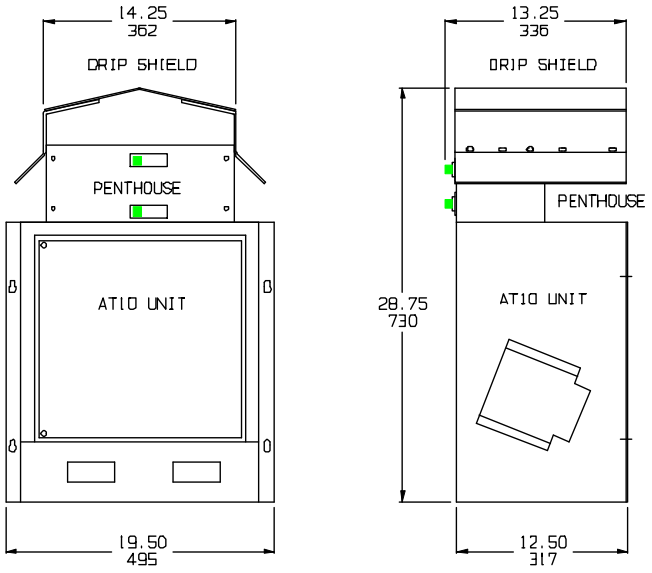


PENTHOUSE AND DRIP SHIELD
COMBINATION OUTLINE

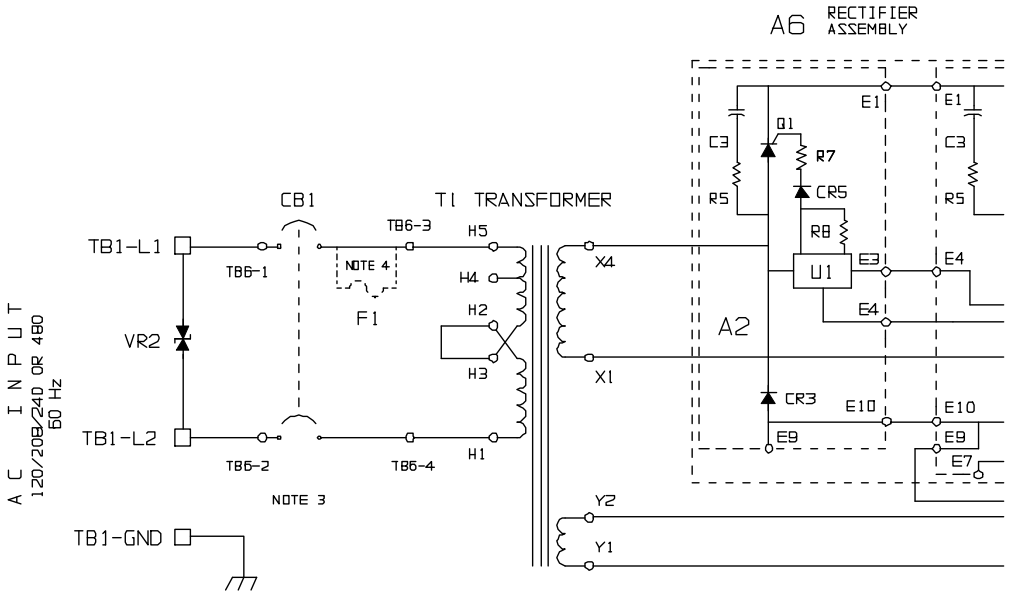
LARGE ENCLOSURE 594 WITHOUT PENTHOUSE

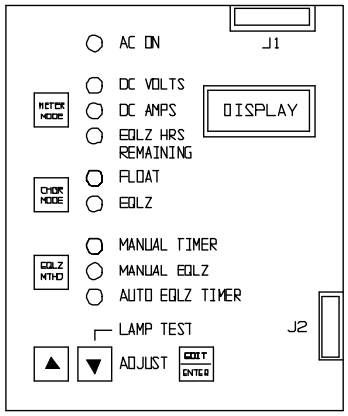


LARGE ENCLOSURE 594 WITH PENTHOUSE



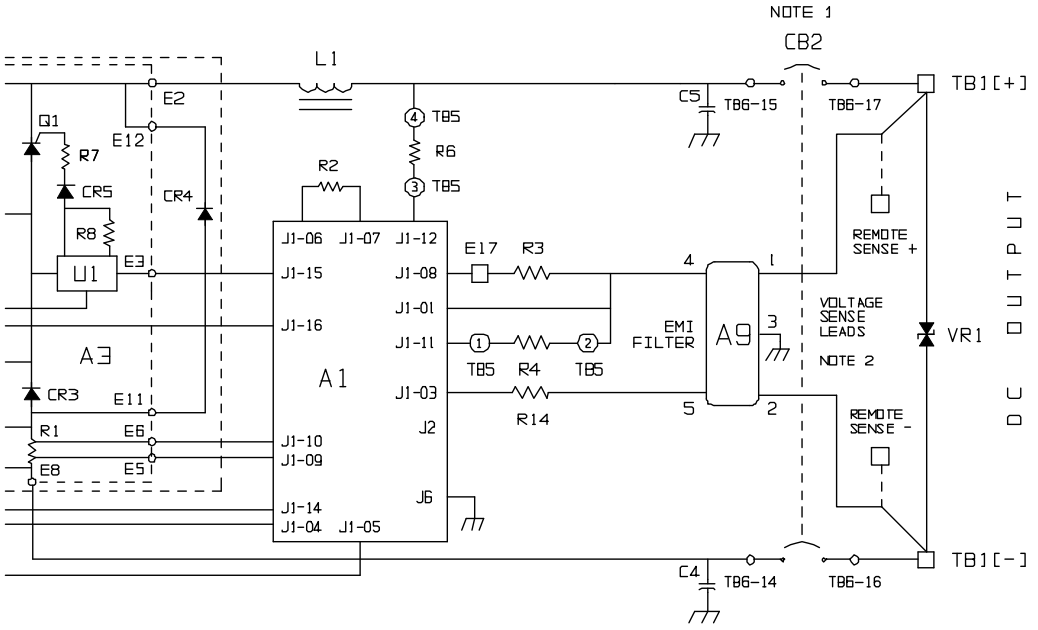
APPENDIX C





A1: CONTROL BOARD

SCHEMATIC,
AT10 BATTERY CHARGER
WITH NO OPTIONS



T1 CONNECTION TABLE		
	INPUT	JUMPER
STANDARD TRANSFORMER	120	H1-H3, H2-H5
	208	H2-H4 (2)
	240	H2-H3 (2)
(OPTIONAL) TRANSFORMER	480	NONE

NOTES:

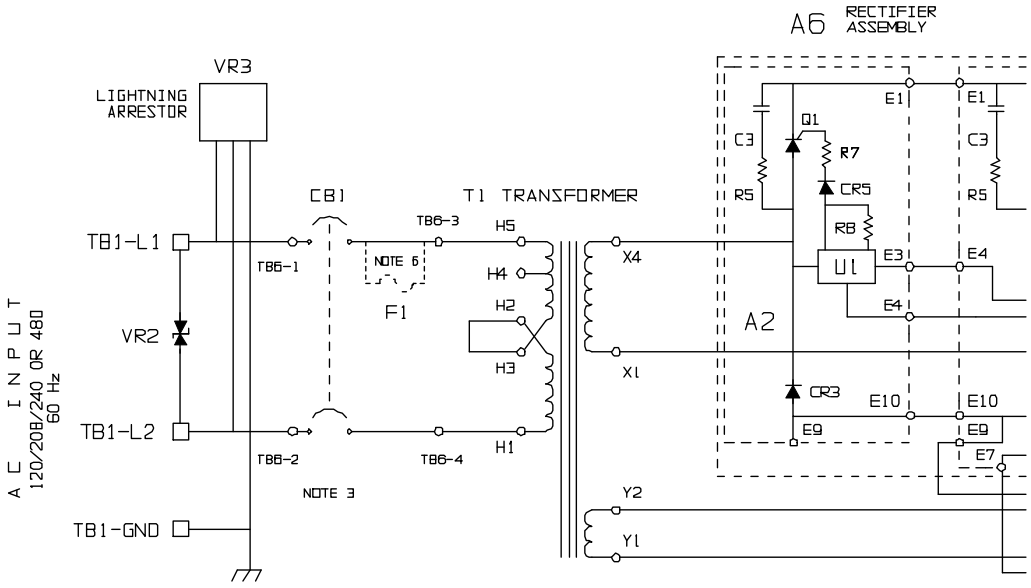
1) CB2 IS A TWO POLE BREAKER IN 130VDC UNITS ONLY. 12, 24 AND 48VDC UNITS CONTAIN A SINGLE POLE BREAKER IN THE NEGATIVE BUS. EXECPTION: MEDIUM AND HIGH AIC BREAKERS, WHEN USED, 2 POLE FOR ALL UNITS.

2) WHEN REMOTE SENSE IS USED, THE VOLTAGE SENSE LEADS ARE MOVED FROM TB1 + AND - TO REMOTE SENSE + AND -. REFER TO CONNECTION DIAGRAM FOR DETAILS.

3) TB6 INTERCONNECTION BLOCK IS USED WHEN MEDIUM AND HIGH INTERRUPTING CAPACITY BREAKERS ARE SUPPLIED.

4) F1 FUSE IS USED ONLY ON THOSE UNITS SPECIFIED WITH 480VAC INPUT.

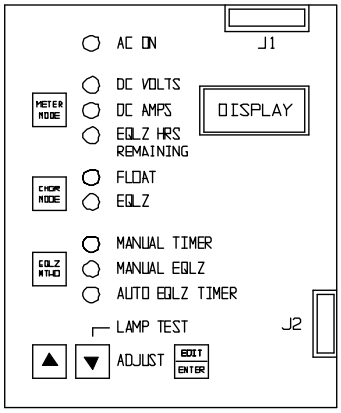
APPENDIX C



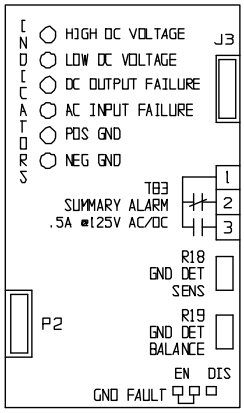
T1 CONNECTION TABLE	
INPUT	JUMPER
120	H1-H3, H2-H5
208	H2-H4 (2)
240	H2-H3 (2)
480	NONE

STANDARD TRANSFORMER

(OPTIONAL) TRANSFORMER

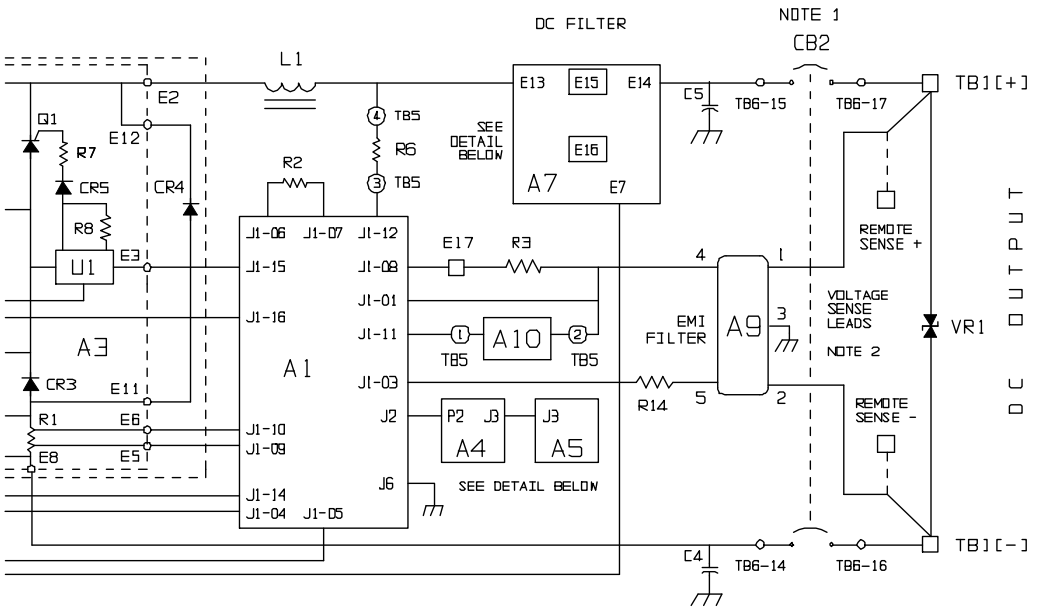


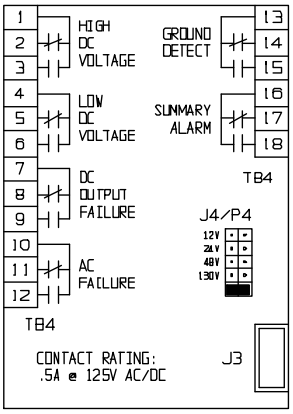
A1: CONTROL BOARD



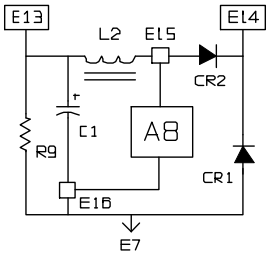
A4: PRIMARY ALARM BOARD

SCHEMATIC,
AT10 BATTERY CHARGER
WITH ALL OPTIONS

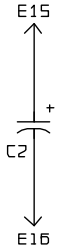




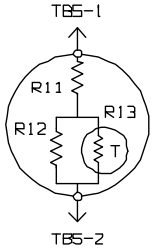
A5: AUXILIARY RELAY BOARD



A7: FILTERING ASSY.



A8: BATTERY ELIMINATOR FILTER



A10: TEMPERATURE COMPENSATION PROBE (NOTE 5)

NOTES:

1) CB2 IS A TWO POLE BREAKER IN 130VDC UNITS ONLY. 12, 24 AND 48VDC UNITS CONTAIN A SINGLE POLE BREAKER IN THE NEGATIVE BUS. EXECPTION: MEDIUM AND HIGH AIC BREAKERS, WHEN USED, 2 POLE FOR ALL UNITS.

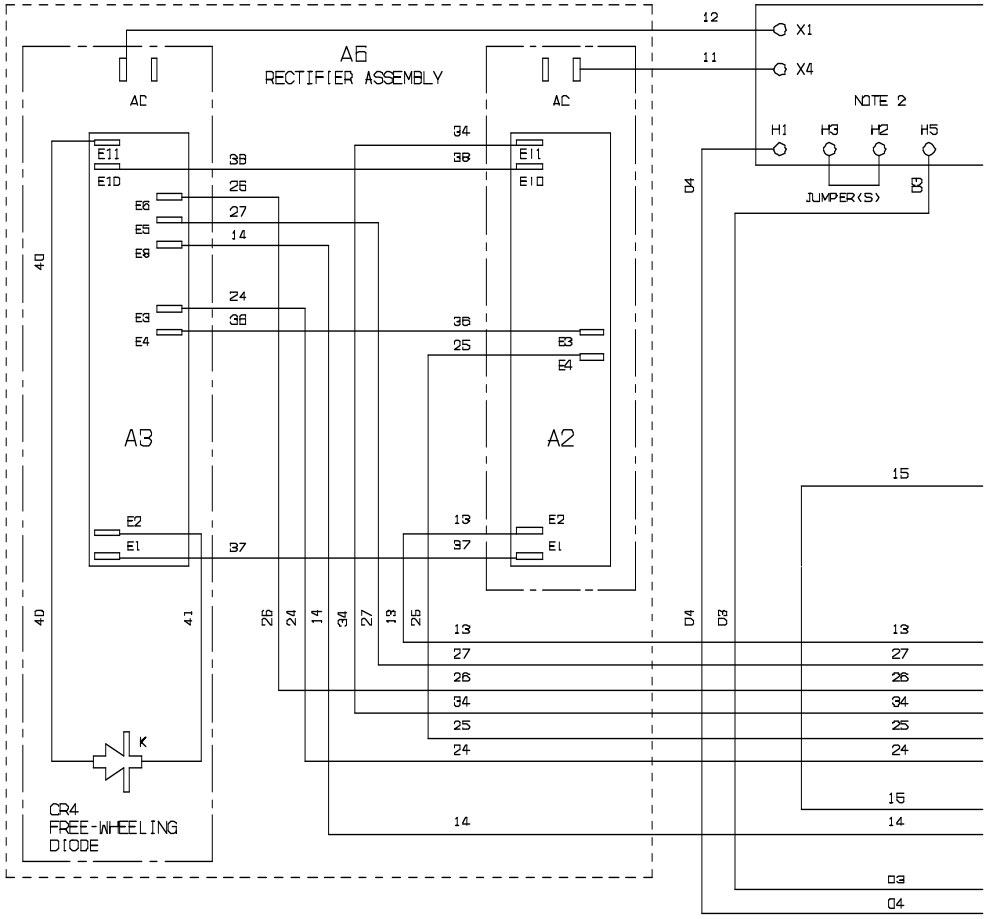
2) WHEN REMOTE SENSE IS USED, THE VOLTAGE SENSE LEADS ARE MOVED FROM TB1 + AND - TO REMOTE SENSE + AND -. REFER TO CONNECTION DIAGRAM FOR DETAILS.

3) TB5 INTERCONNECTION BLOCK IS USED WHEN MEDIUM AND HIGH INTERRUPTING CAPACITY BREAKERS ARE SUPPLIED.

4) ALL ALARM CONTACTS SHOWN IN NON-ALARM STATE.

5) A10 REPLACES R4 WHEN TEMPERATURE COMPENSATION IS USE.

6) F1 FUSE IS USED ONLY ON THOSE UNITS SPECIFIED WITH 480VAC INPUT.



NOTES.

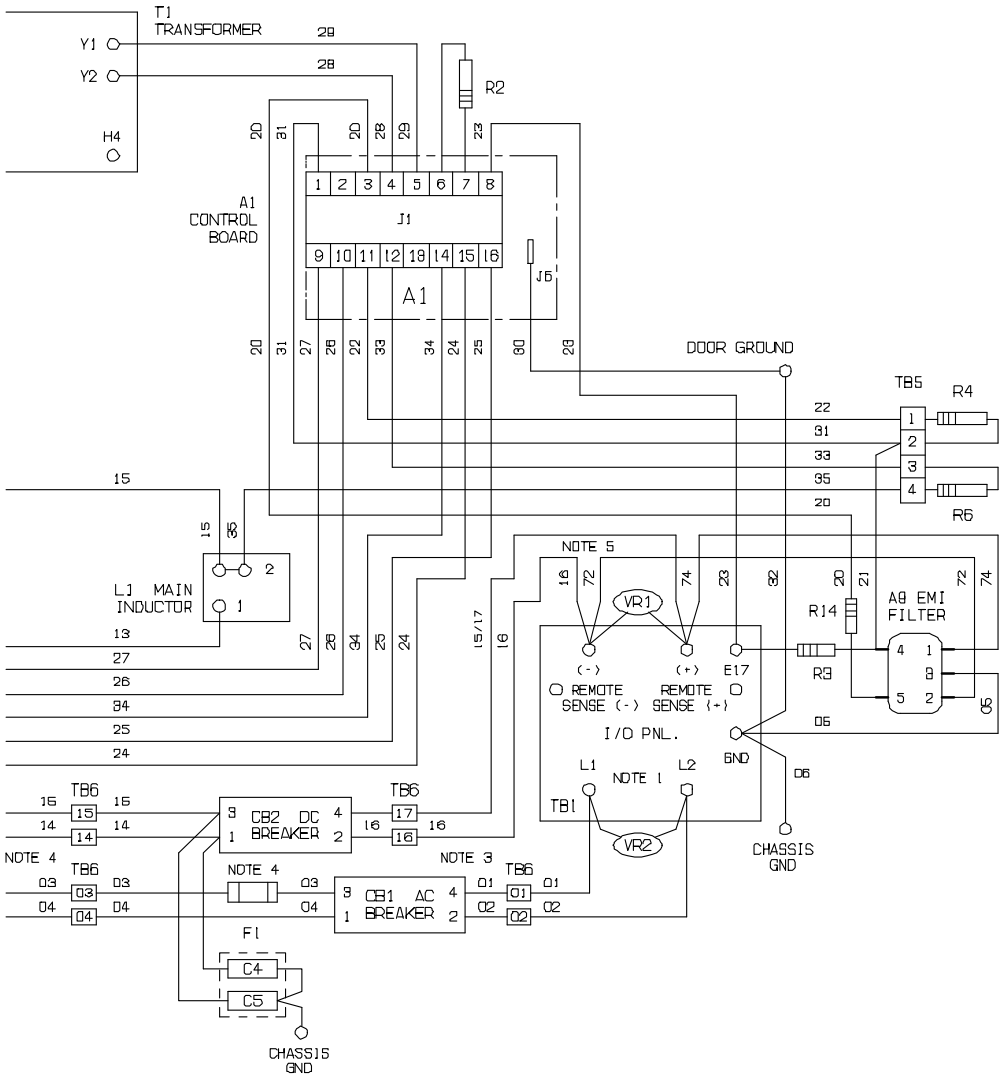
1) FOR REMOTE SENSING, WIRE #74 IS MOVED FROM TB1(+) TO REMOTE SENSE (+), AND WIRE #72 IS MOVED FROM TB1(-) TO REMOTE SENSE (-).

2) SEE SCHEMATIC FOR T1 TRANSFORMER PRIMARY CONNECTION TABLE.

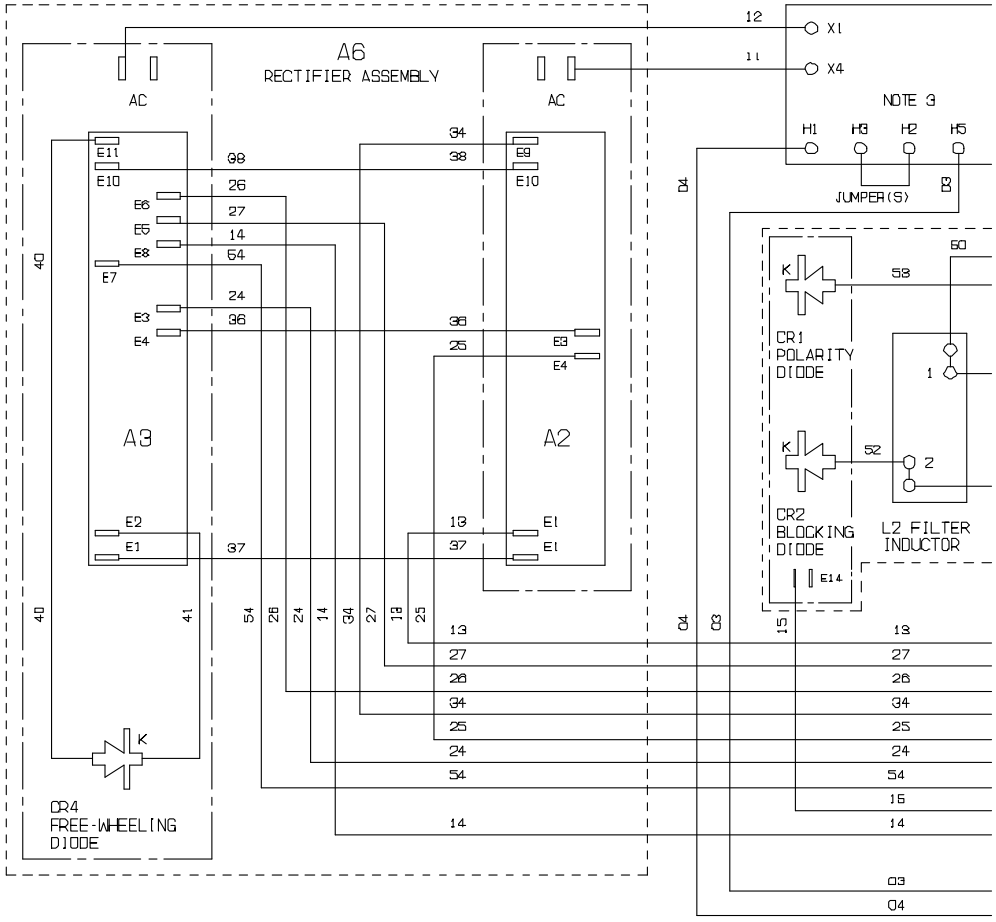
3) TB6 IS AN INTERCONNECTION BLOCK USED WHEN MEDIUM AND HIGH INTERRUPTING CAPACITY BREAKERS ARE SUPPLIED.

4) F1 IS USED ONLY ON THOSE UNITS SPECIFIED WITH 480 VAC INPUT.

5) CB2 IS A SINGLE POLE CIRCUIT BREAKER IN THE NEGATIVE BUS FOR 12V, 24V AND 48VDC UNITS, ONLY WHEN STANDARD BREAKERS ARE SUPPLIED. FOR THESE UNITS, WIRE #15 TERMINATES AT TB1(+) AND WIRE #17 IS NOT USED.



CONNECTION DIAGRAM,
AT10 BATTERY CHARGER
WITH NO OPTIONS



NOTES:

1) FOR REMOTE SENSING, WIRE #74 IS MOVED FROM TB1(+) TO REMOTE SENSE (+); AND WIRE #72 IS MOVED FROM TB1(-) TO REMOTE SENSE (-).

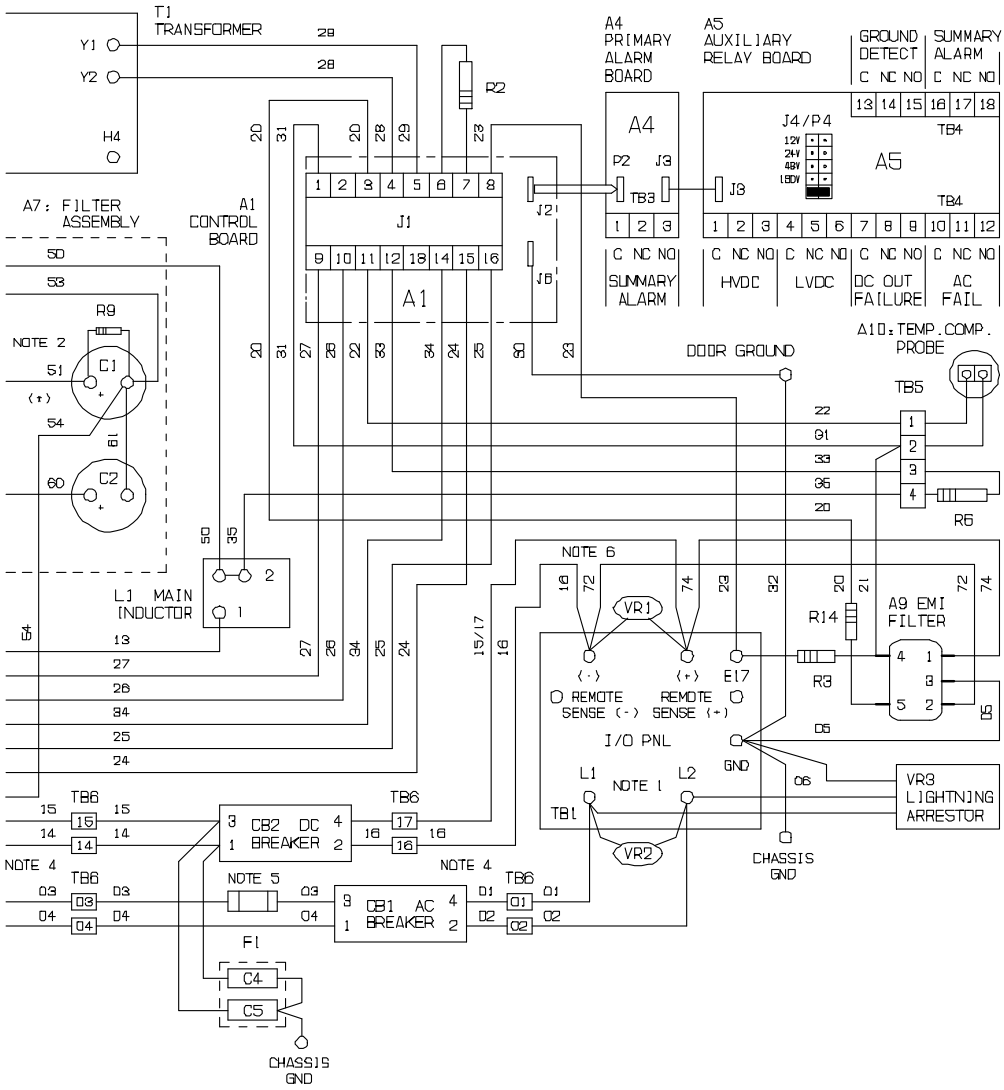
2) C1 CONSIST OF (2) CAPACITORS CONNECTED IN PARALLEL FOR 180VDC 12ADC, 16ADC, 20ADC, AND 25ADC UNITS.

3) SEE SCHEMATIC FOR T1 TRANSFORMER PRIMARY CONNECTION TABLE.

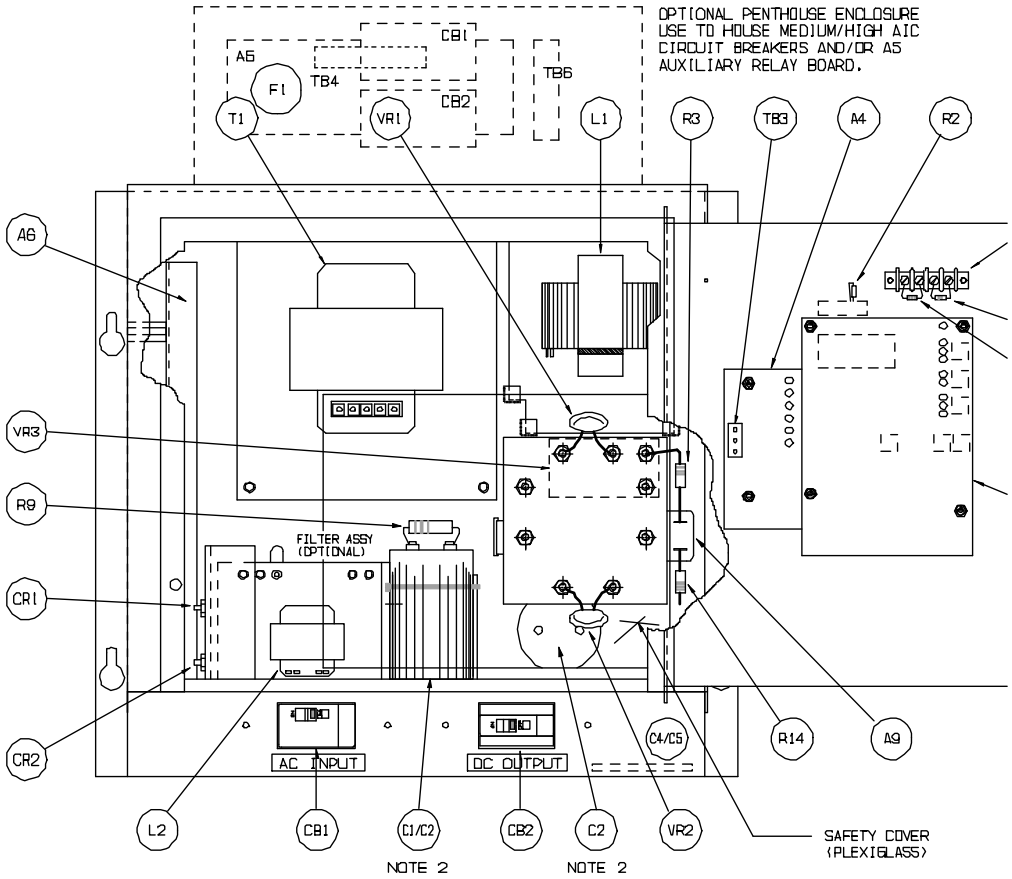
4) TB6 IS AN INTERCONNECTION BLOCK USED WHEN MEDIUM AND HIGH INTERRUPTING CAPACITY BREAKERS ARE SUPPLIED.

5) F1 IS USED ONLY ON THOSE UNITS SPECIFIED WITH 480 VAC INPUT.

6) CB2 IS A SINGLE POLE CIRCUIT BREAKER IN THE NEGATIVE BUS FOR 12V, 24V AND 48VDC UNITS, ONLY WHEN STANDARD BREAKERS ARE SUPPLIED. FOR THESE UNITS, WIRE #15 TERMINATES AT TB1(+) AND WIRE #17 IS NOT USED.



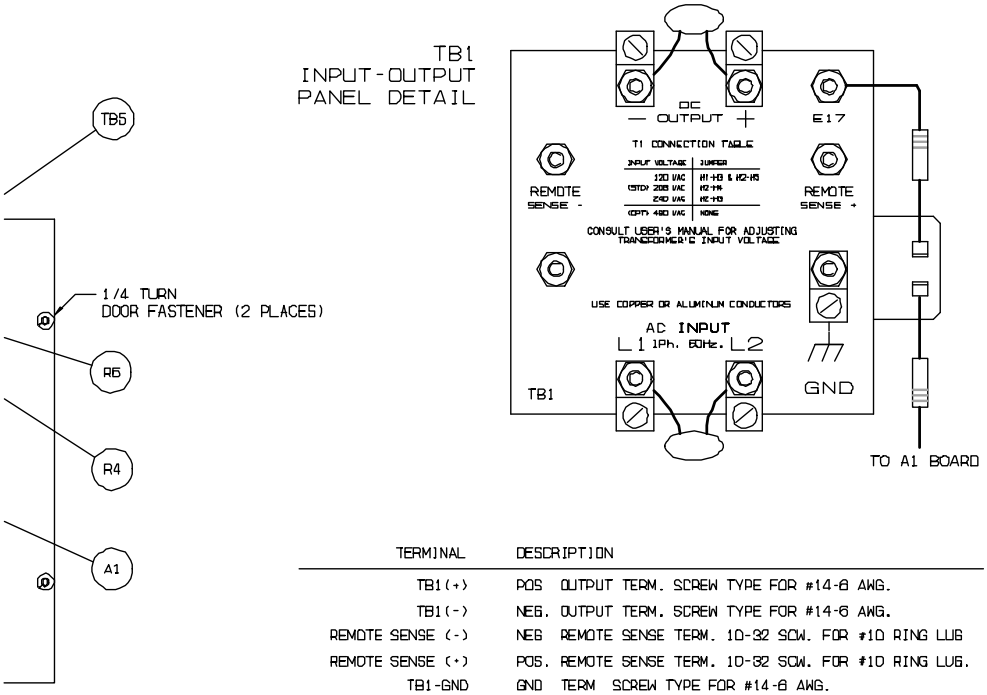
CONNECTION DIAGRAM,
AT10 BATTERY CHARGER
WITH ALL OPTIONS



NOTES:

1. WHEN MEDIUM/HIGH AMPS INTERRUPTING CAPACITY CIRCUIT BREAKERS ARE SUPPLIED CB1 AND CB2 ARE LOCATED IN PENTHOUSE ENCLOSURE.
2. C2, FILTER ELIMINATOR CAPACITOR IS NORMALLY LOCATED ABOVE C1. 130V 12 THRU 25A UTILIZE (2) C1'S AND THEREFORE C2 IS SHIFTED TO LOWER RIGHT-HAND CORNER OF ENCLOSURE AS SHOWN.
3. DATA NAMEPLATE IS LOCATED ON EXTERIOR LEFT SIDE WALL OF ENCLOSURE; AND USER'S MANUAL POCKET IS LOCATED ON EXTERIOR RIGHT SIDE WALL OF ENCLOSURE.
4. SAFETY COVER DISPLAYS: A) COMPONENT LAYOUT
   B) SCHEMATIC
   C) INSTALLATION NOTES

INTERNAL COMPONENT LAYOUT;
AT10 BATTERY CHARGER



TERMINAL	DESCRIPTION
TB1(+)	POS OUTPUT TERM. SCREW TYPE FOR #14-6 AWG.
TB1(-)	NEG. OUTPUT TERM. SCREW TYPE FOR #14-6 AWG.
REMOTE SENSE (-)	NEG REMOTE SENSE TERM. 10-32 SCW. FOR #10 RING LUG
REMOTE SENSE (+)	POS. REMOTE SENSE TERM. 10-32 SCW. FOR #10 RING LUG.
TB1-GND	GND TERM SCREW TYPE FOR #14-6 AWG.
TB1-L1	AC. INPUT TERM. SCREW TYPE FOR #14-6 AWG.
TB1-L2	AC. INPUT TERM. SCREW TYPE FOR #14-6 AWG.
TB3	SUMMARY ALARM RELAY CONTACTS (OPTIONAL) w/ COMPRESSION TYPE FOR #18-12 AWG.

SYMBOL	DESCRIPTION
A1	CONTROL CIRCUIT BOARD
A4	PRIMARY ALARM BOARD (OPTIONAL)
A5	AUXILIARY RELAY BOARD (OPTIONAL)
A6	RECTIFIER ASSEMBLY
A9	EMI FILTER ASSEMBLY
C1	FILTER CAPACITOR (OPTIONAL)
C2	BATT ELIMINATOR FILTER CAPACITOR (NOTE 2)
C4	EMI FILTER CAPACITOR
C5	EMI FILTER CAPACITOR
CB1	AC INPUT CIRCUIT BREAKER
CB2	DC OUTPUT CIRCUIT BREAKER
CR1	POLARITY DIODE
CR2	BLOCKING DIODE
F1	AC INPUT FUSE (480 VAC INPUT ONLY)
L1	MAIN INDUCTOR
L2	FILTER INDUCTOR (OPTIONAL)

SYMBOL	DESCRIPTION
R2	RATING RESISTOR
R3	POWER RESISTOR
R4	SCALING RESISTOR, POSITIVE SIDE
R6	CROWBAR RESISTOR
R9	BLEED RESISTOR
R14	SCALING RESISTOR,NEGATIVE SIDE
T1	TRANSFORMER
TB3	COMMON ALARM RELAY CONTACTS (OPTIONAL)
TB4	AUXILIARY RELAY TERMINAL BLOCK (OPTIONAL)
TB5	R4 / R6 TERMINAL BLOCK
TB6	MEDIUM/HIGH AIC CB TERMINAL BLOCK
VR1	OUTPUT SURGE SUPPRESSOR
VR2	INPUT SURGE SUPPRESSOR
VR3	LIGHTNING ARRESTOR (OPTIONAL)

APPENDIX D

CAUTION

To operate this charger from inputs other than 120 Vac, you must use branch circuit protection. To reduce the risk of fire, use only on circuits provided with the following branch circuit protection in accordance with the National Electrical Code, ANSI/NFPA 70.

Current Rating	Charger Voltage Rating			
	48V	130V	48V	130V
12A	---	25A	---	20A
16A	15A	25A	12A	20A
20A	20A	30A	15A	30A
25A	25A	40A	20A	35A
	208 Vac Branch Circuit Protection (Amperes)		**240 Vac Branch Circuit Protection (Amperes)**	

Note: This table does not apply to AT10 chargers with 480 Vac input.

QUICK OPERATION

For unpacking and installation instructions, see section 1 on page 2 in this manual

Startup

- Turn on the dc breaker, labeled "**DC OUTPUT**".
- Turn on the ac breaker, labeled "**AC INPUT**".

To learn how to use the equalize timers, see sections 2.2.4 on page 27 and 2.3.3 on page 33

Changing between Float and Equalize Modes

- Press the CHRG MODE key to toggle from Float mode to Equalize mode. Press again to toggle back to Float. The green or yellow indicator identifies the current mode.

For details on setting parameters, see section 2.3 starting on page 31

Setting

Float Voltage
Equalize Voltage
Equalize Timer
High DC Voltage
Low DC Voltage
Current Limit

If you don't press any key for 25 seconds, the AT10 resumes normal operation automatically

- Press the EDIT ENTER key. The **DC VOLTS** and **FLOAT** indicators light, and the digital display flashes the present float voltage setting.
- Press the ⬆ or ⬇ key until the digital display indicates the desired float voltage.
- Press the EDIT ENTER key to save the new setting internally.
- The **EDIT** sequence advances to the equalize voltage as shown by the front panel indicators. Repeat the above steps until you have set all parameters.

(http://www.atseries.net/PDFs/JA0102-00.pdf) p/n **JA0102-00** - Rev. 11-2001