HEHR POWER SYSTEMS

AQUALINE MARINE REGULATOR OWNERS MANUAL

09/20/98

This regulator is a continuation of, and an improvement upon, the 1997 version of our marine regulator. It retains all the features of the previous model and offers the following changes / improvements:

I. A new tachometer drive circuit ensures stable operation during the first two minutes of operation and during the float mode at the end of the charging cycle. Previous models showed erratic tach. operation during the first two minutes and were likely to let the tach drop out during float Mode (a natural consequence of soft, trickle charging when there is essentially no alternator output).

2. A new waterproof connector contains 8 of the 14 input / output connections on the regulator. This improves corrosion resistance of the regulator's terminals. Male 1/4 inch spade terminals for the GEL / EQUALIZATION jumper and the thermal probe are still exposed so that connectors can be applied and removed.

3. A modified wiring harness provides more flexibility in making tach. ignition, & dual alternator connections. Because of the unique connector, our part numbers for the regulator and wiring harness have changed. Each regulator is shipped with an 11-91 wiring harness for new installations. If you need to replace an older 10-82 with a new 10-184 model, an 11-89 wiring "pigtail" is required to interface the new connector to the old wiring harness. NOTE - This version of the regulator does **not** have an on-board fuse or an internal fuse blow circuit. It is intended to be used with a fused wiring harness such as those found on 1996 & 97 Aqualine models. **DO NOT USE THE CONVERSION PIGTAIL TO SPLICE INTO UNFUSED WIRING ON 1994 / 95 REGULATORS YOU WILL HAVE NO PROTECTION AGAINST CATASTROPHIC FAILURE.** When replacing 1994 / 95 model regulators, install a new wiring harness.

I. MODELS / APPLICATION AND FEATURES:

The new Aqualine family contains two versions:

a) Model 10-184 is the 12 volt version intended for use with either single or dual alternators. Dual output transistors make it suitable for any size alternator (Series 23, 24, or 25) with field current up to 7 amps each / 15 amps total.

b) Model 10-185 is a 24 volt version with dual output transistors capable of 15 amps field current (Total). It is meant for single or dual alternators (Series 24, or 25). Each of these regulators is shipped with an 11-91 wiring harness that is set up for a Series 23 (small case) alternator. **IF YOU HAVE A SERIES 24 OR 25 ALTERNATOR**, you will have to modify the alternator plug to fit the field and stator connections. Parts are included in a plastic bag to do this (SEE FIGURE 3).

Series 24: 0115504 Alternator plug and two 0135189 female receptacles that insert into the plug.

Series 25: two 0135510 ring terminals for attaching to screws on the brush plate, plus a ground wire.

c) An optional thermal probe is available in 3 lengths to protect batteries against high temperatures: 10-186 is 15 feet long, 10-187 is 25 feet long, 10-188 is 35 feet long

FEATURES:

The Aqualine is a “smart” 3 step regulator based around an embedded micro controller. It contains a number of features that ordinary regulators do not have. These are intended to optimize charging of expensive batteries , to protect delicate equipment like Halogen lamps, and to provide special features such as battery equalization. This regulator is a "high side" device intended for use with "P" type alternators only. It cannot be used with alternators which are regulated through the ground side of the field winding. It features:

1) a "soft start" 90 second turn on delay to minimize belt stress. Green LED is on continuously.
2) Stepped voltage after regulator time out: 12.7, 13.3, 14.2 volt steps 20 seconds apart (10-184)
   25.3, 26.6, 28.4 volt steps 20 seconds apart (10-185)

3) Three step charging with Bulk, Absorption, and Float modes. The FLOAT MODE is reached after 90 minutes continuous of V(Batt.) at or above the set point. In FLOAT, the green LED glows continuously and charging voltage drops to 13.4 volts (26.8 V for the 10- 185) to gently "top off batteries. The regulator will still drive a load during "FLOAT" but if the battery voltage pulls down, the regulator returns to the Absorption mode.
4) Gel Cell protection. Placing the GEL jumper over the spades shown in Figure 1B changes the regulator set point to 13.7 VDC for 10-184 or 27.5 VDC for 10-185. **WITH JUMPER ON, THE VOLTAGE ADJUST POT HAS NO CONTROL.**
5) Halogen light protection. If the fight switch is connected to the HAL lead, system voltage drops to 13 VDC (or 27.5 for the 10-185) when the lights are turned on.
6) Short circuit protection on Field terminal. The regulator turns OFF if F gets shorted. Reset is automatic (takes 40-60 seconds) if the short goes away. If the regulator does not reset, you will have to shut the system down and find the cause of the problem before re-starting.
7) Over Voltage protection is provided only by the regulator turning off. If the regulator's output transistor fails short, the only protection is a fuse in the wiring harness.
8) Battery over-temperature protection - only when an optional thermal probe is ordered (See Caution on page 3 . Set point voltage steps down to 11.7 volts (or 27.5 VDC) at 120 F battery temperature. Reset is automatic when Battery temperature drops to 100 F.
9) Green LED signals to indicate:
   * turn-on delay (continuous for first 90 seconds).
   * float mode (continuous at some point beyond 90 minutes into charging cycle).
   * over-temperature (I blink)
   * short circuit (2 blinks)
   * missing / blown harness fuse or over-voltage condition (3 blinks)

NOTE: When you install a mode indicator lamp, it will flash the error codes in sync with the regulator LED to provide a signal at the operator control station. 10) This regulator contains two potentiometers that are accessible for customer adjustment:

- The Voltage Adjust Pot. (near wall of the module) is the traditional Set Point adjustment. It is factory set for 14.2 V (10- 184) or 28.4 V (10- 185) at light load / third step. You may want to change it to accommodate battery chemistry or to take fine drops into account.
- The-Duty Cycle Pot. (closest to the spade terminals) can be used to artificially limit the maximum output of the alternator during normal operation or to limit charging current during battery equalization. See the instructions on page 5/6 for performing these adjustments.

11) BATTERY EQUALIZATION PROCEDURE:

This procedure is designed to rejuvenate a deep cycle marine battery that has been repeatedly depleted and to equalize individual cell voltages. Because it involves a vigorous charging regimen, it should be done only when necessary - preferably once a month or less. Frequency will depend on use conditions, age condition of the battery, etc. so the boat owner needs to develop a battery monitoring technique.

When you think a battery is sulfated up or otherwise in need of rejuvenation, choose a time when you can remove all external loads from the battery and run the engine for about 4 hours. Then follow the detailed instructions in the last section of this document. ***CAUTION !*** **Hehr Power Systems does not recommend equalizing gel cell batteries unless the battery manufacturer has approved such a procedure.**

12) SPECIAL NOTES:

a) The new tachometer drive circuit amplifies the stator signal and produces a signal level of 14 or 28 volts (compared to typical 6 or 14 volts). MAKE SURE YOUR TACHOMETER WILL STAND AN INPUT SIGNAL EQUAL TO THE POWER SUPPLY VOLTAGE (most models will).

b) It is important to use a mode indicator light in the ignition circuit. This lamp must be an incandescent bulb, not an LED. Old fashioned automotive bulbs work best - the kind with a cylindrical base that push down into a socket and rotate 90 degrees to lock.

It should draw approximately .12 Amps. This equates to a room temperature DC resistance of 5-220 ohms. Lamp numbers known to work well are

* GE #53 * #1815
* Cole Hersee M-320-RC Cole Hersee PL 20RC013

THE REGULATOR WILL WORK WITH BATTERY VOLTAGE DIRECT TO THE "I" TERMINAL UNDER NORMAL CONDITIONS. But if transients or abnormal conditions cause the micro controller to lose control, a resistor can overheat causing the potting epoxy to smoke. **WE CANNOT GUARANTEE TROUBLE-FREE OPERATION WITHOUT AN INDICATOR LAMP!!**

II. CONNECTIONS AND WIRING INSTRUCTIONS (Please refer to the attached drawings.)

Mount the regulator in a location which will be reasonably dry and is not likely to exceed 150 F temperature. Our wiring harness assumes this will be within 5 feet of the alternator or battery. A vertical mounting, position is best to prevent water from collecting around the spade terminals and to allow air to circulate around the heat sink fins. The heat sink does not have to be grounded - it is electrically isolated from the circuitry.

FIGURE 1A shows the layout of the module and the function of each pin on the 9 pin connector.

* Pin I is the tachometer drive circuit and should be connected to the SEND terminal of alternator driven tachometers (where stator is normally hooked).
* Pin 2 is the output and connects to the alternator field winding.
* Pin 3 is the Ignition terminal and requires a turn on signal to activate the regulator. Wire to the Ignition switch thru an indicator lamp.
* Pin 4 is a remote sense connection which goes directly to the battery or a selector switch. THE REGULATOR WILL NOT WORK WITHOUT BATTERY VOLTAGE ON THIS LEAD.
* Pin 5 is the regulator ground.
* Pin 6 requires a stator connection from the alternator to turn off the indicator lamp.
* Pin 7, the A terminal (power supply) for the regulator - requires battery voltage at all times.
* Pin 8 is used if you have halogen lights on your boat. Connect to the low side of the light switch.
* Pin 9 is not used - no connection. Leave the plug in the hole to keep water out.

FIGURE IB shows the location of the six spade terminals and the two potentiometers.

* The group of 3 spades closest to the wall are used to manually select and activate two features:
  - **GEL CELLS** - when a jumper is used to join these 2 spades, the system voltage is reduced 0.5 volts for 14 volt systems or I volt for 28 volt systems.
  - **EQUALIZATION** - when the jumper is used to join these 2 spades, the Equalization routine is activated. See instructions on Page 5 / 6.
* The group of 3 spades closest to the Duty Cycle potentiometer is for a thermal probe. If you have purchased the optional thermal probe, its connector plugs onto these spades. Make sure it is connected before starting the engine. CAUTION! If you are replacing an older AQUALINE regulator having a 10-83, 10-99, or 10-113 thermal probe, YOUR OLD THERMAL PROBE CANNOT BE USED AS IS ON THE NEW REGULATOR! A simple wire change is required to reverse position of 2 wires - see Figure 8 for instructions.

NEW INSTALLATIONS:

1) Use the 11-91 harness packed with the regulator. Figure 2 shows what it looks like. The "stub" at the regulator end of the harrnss allows you flexibility in wiring. The Ignition and tachometer connections can be made at either end of the harness. Align the white rectanglar plug with the mating 9 pin connector on the regulator and push down firmly until the snaps engage. The connector is keyed so it only fits one way. Then Connect the other ends of the harness to the alternator and battery per Figure 4 or Figure 5.
   - Single battery system. Connect per Figure 4 except Pins 4 and 7 on the connector (red and red white stripe wires) go directly to the POS terminal of the battery (no selector switch).
   - Multiple battery system with battery selector switch. Connect per Figure 4
   - Multiple battery system with Isolator (instead of a selector switch). Connect per Figure 5. Make sure you connect the red and red /white Wire to the battery that you most need to control -usually the most heavily loaded one.

2) If you have Halogen lights on your boat, Connect the light switch to the pink / black wire (HAL pin).

3) If you purchased the optional thermal probe, plug the 3 prong plastic connector over the group of 3 spades closest to the Duty Cycle potentiometer and connect the ring terminal to the POSITIVE post of the battery you want to protect.

4) If you are using gel cell batteries and want the charging system voltage limited to 13.8 volts (27.6 in 28 volt systems) place the 2 terminal jumper plug over the pair of spades shown in Figure IB as the “GEL JUMPER POSITION".

THIS JUMPER WILL BE USED PERIODICALLY TO MANUALLY ACTIVATE THE BATTERY EQUALIZATION ROUTINE. SINCE WE DO NOT RECONUAEND THIS PROCEDURE ON GEL CELLS, THE SPADES ARE SET UP SO THAT GEL AND EQUALIZATION CANNOT BE ACTIVATED SIMULTANEOUSLY.

REPLACING OLDER REGULATORS:

This section tells how to use a 10-184 to replace an older 10-82 or 10- 115 (12 volt) regulator or a 10-185 to replace an older 10-118 (24 volt) regulator. The date code on the old regulator must be 1996 or 1997 to keep the existing wiring harness. If you have a 1994 or 95 model, install the new harness. Look for a four digit number on the back of the heat sink - it contains the year and the week of manufacture. 9620 for example means the 20th week of 1996. Now look at the wiring harness and verify that the red wire and red white stripe wire are fused and that fuses are in place and good. Red wire should have an in-line 10 or 15 amp ATC fuse, the red/white wire a 5 amp in-line fuse.

To connect a new regulator into the old wiring harness, you will need an 11-89 conversion "pigtail".

The 11 -89 is a short harness with a 9 pin mating connector on one end and loose wires with butt connectors on the other ends. Splicing the adapter into the old harness requires 8 cuts, strips and crimps.

1. Start by identifying and labeling the leads and corresponding wire colors on the old regulator. Figure Six shows that information for 1996 and 1997 models. The instructions below identify what the colors in the old wiring harness "should” be, but you must verify them by function / location.
2. Now remove the 4 terminal plastic connector from the old regulator. Also disconnect the black ground wire and the red/white SENSE wire.
3. Remove the screws holding the old regulator heat sink in place and mount the new regulator instead.
4. Take the 11-89 conversion "pigtail", orient the 9 pin plastic plug with the connector on the new regulator, and plug it in. Push down firmly until the snaps engage.
5. Now connect the loose ends of the "pigtail” to the old wiring by cutting loose one old wire at a time and crimping it into the correct butt connector as follows:
   * Pin I on the new regulator (red/yellow wire) goes to the "sender" terminal on your tachometer (the lead which normally 'gets a stator connection). There is probably a white stator wire connected to the tach presently - remove it and tape it off to prevent unintended connections. Run a new wire from SEND back to the red/yellow wire on the new regulator and crimp it into the butt connector.
   * Pin 2 of the new regulator (blue wire) is the Field connection and goes to the F terminal of the old regulator (should be a blue wire also).
   * Pin 3) of the new regulator (brown wire) goes to the I terminal of the old regulator (should be a brown wire also). If there is no indicator lamp in the circuit, add one.
   * Pin 4 of the new regulator (red/white wire) goes to the EXT. SENSE terminal on the old regulator (should be a red/white wire also).
   * Pin 5 on the new regulator (black wire) goes to the Ground (GND) terminal on the old regulator. Should be a black wire also.
   * Pin 6 on the new regulator (white wire) goes to the S terminal on the old regulator. Should be a white wire also.
   * Pin 7 on the new regulator (red wire) goes to the A terminal on the old regulator. Should be a red wire also.

Pin 8 on the new regulator (pink / black wire) goes to the HAL spade on the old regulator (wire color unknown). As on all the old wires above, cut the receptacle off the wire that went to HAL, strip 1/4 inch, and crimp it into the butt connector on the pink / black wire. If no halogen lights are used, tape the pink/black wire off to an adjacent wire to prevent shorting. Pin 9 on the new regulator (white / black wire) is not used. Tape it off safely to an adjacent wire. If a thermal probe was used on the old regulator, lift the 31 terminal connector off the old regulator. Now rewire it per instructions of Figure 8, then push it down on the corresponding group of 3 spades on the new regulator.

7. If you have gel cell batteries and used a gel Jumper on the old regulator, pull the jumper off the old regulator and apply it over the proper pair of spades on the new regulator. See Figure I B for location.

DUAL ALTERNATORS:

For either new installations or replacing old regulators, run the alternator harness (the primary bundle) to the primary engine / alternator - the one that you always use. This ensures that the regulator will always have a stator signal to operate the indicator lamp. Drive the tachometer for this engine from Pin I of the regulator. **IF YOU HAVE ALARMS THAT ARE CONNECTED TO A TACHOMETER, MAKE SURE IT IS THIS ONE !** It is protected against dropout during float mode.

Now connect the field of the second alternator in parallel with the first per Figure 7A (isolator) or 7B (selector switch). Make this connection thru a switch rated at 32 volts / 7 amps so that you can "turn on" the second field only when the second alternator is running. Connect the tachometer for the second engine directly to its alternator's stator tap. This tachometer may experience erratic operation during the regulator's start up sequence or during float mode. NOTE: Figure 7A is the preferred hook-up. In Fig. 7B, stator failure on one alternator can take out the second one also !

POTENTIOMETER ADJUSTMENT AND BATTERY EQUALIZATION PROCEDURES

CAUTION - turn potentiometer screws slowly and gently with a jeweler's screwdriver. These are one turn pots with a plastic stop at each end. If you break the stop off, the pot. is ruined!!

A. SYSTEM VOLTAGE (SET POINT) ADJUSTMENT:
   1) Make sure the Duty Cycle Pot. (Center of module) is turned fully counter-clockwise.
   2) Start the engine & wait 4 minutes for the regulator to time out & reach its third step. LED must be off.
   3) Connect a voltmeter directly across the GROUND and REMOTE SENTSE connections at the Batt. end of the wiring harness POS lead to SENSE, NEG lead to GNID. Verify that reading is above 13.6 Volts DC in a 12 V system or 27 volts in a 28 V system (alternator is working).
   4) Remove all unnecessary loads from the electrical system to set up a light load condition.
   5) Watch the reading on the voltmeter while you SLOWLY turn the adjustment screw on the VOLTAGE ADJUST pot. (near module wall) until desired voltage is reached. CW (clockwise) increases voltage. Record voltage.
   6) Now use the voltmeter to measure the voltage at each battery (battery bank) - directly across the terminals. The voltage across the battery being sensed should be the same as the final reading in step 5. Any other battery should be within 0.5 volts of that reading when connected to the alternator. If not, check the system for problems such as loose connections, inadequate sized cable. Etc. Only the presence of an isolator is a valid reason for excessive voltage drops / differences in the system. NOTE. It might be wise to make this voltage comparison again later under heavier load conditions. This will make it harder to keep voltages at different points equal, but they should be close (certainly **not** volts apart) !!

B. DUTY CYCLE LIMITING:

If the Duty Cycle pot. is turned more than 1/4 turn clockwise, the duty cycle limit feature is turned ON. Continuing to turn the screw CW will limit the amount of field current available, which in turn will limit the current output of the alternator. It would make sense to do this only if you had a reason to artificially limit the amount of current flowing to the batteries. One effect of this would be to increase the length of the bulk charge cycle.

TO ADJUST DURING NORMAL OPERATION:

1) Batteries should be somewhat depleted.
2) Set up an ammeter to measure the alternator output (or the output of a specific battery). Make sure the meter is capable of reading the level of current expected.
3) Turn ON only those loads that will be on line during routine charging.
4) Start with the Duty Cycle pot. screw fully CCW (counter-clockwise). Start the engine and wait 5 minutes to make sure the LED is out. Then watch the ammeter and turn the adjustment screw 1/4 turn CW, Continue to turn the screw slowly clockwise while watching the meter, and stop when desired current is reached. REMEMBER THAT THIS IS THE MAX CURRENT THE ALTERNATOR CAN DELIVER AS LONG AS THE POT SCREW IS IN THIS POSITION.

C. PERFORMING A BATTERY EQUALIZATION PROCEDURE

1) Prepare the system for Equalization:
   * Disconnect any "good" battery (that does not need Equalization) from the system.
   * Remove all external loads from batteries to be Equalized.
   * Remove vent caps and check fluid levels. Fill to MIN. Level if low. Place dry rags over battery openings to keep them clean and to catch splattering electrolyte.
2) Install an ammeter to monitor the current coming out of the alternator. A clamp-on meter over the POS output cable is easiest to use.
3) ADJUST TBE AQUALINE REGULATOR:
   a) Place the two terminal jumper plug over the EQUAL and +5V spades (the Equalization position shown in Fig. 113).
   b) Start the engine and wait 5 minutes. The regulator should time out (LED OFF) and ramp up to a pre-set voltage (approximately 16 volts for 10-184, 32 volts for the 10-185).
   c) Activate the current limiting feature by using a small screwdriver to turn the Duty Cycle Pot. 1/4 turn CW (clockwise).
   d) Watch the system ammeter, and continue to turn the screw slowly clockwise until the ammeter reading equals 5 to 7 % of the amp hour rating of the battery (or bank of batteries).
      * EXAMPLE: a single 95 amp hour battery should be set to 5 to 7 amps of charging current.
      * EXAMPLE: a bank of four 80 amp hour batteries should be adjusted to a total charging current of 16 to 22 amps if all 4 batteries are left connected.
4) MONITOR THE SEQUENCE:
   The regulator will control the sequence. You may want to put a voltmeter across the terminals of the (one) battery to verify the voltages being, applied.
   During a four hour period, battery voltage will progressively rise from the initial value after duty cycle adjustment (12-13) VDC for 10- 184, or 24-26 VDC for 10 - 185) up to 16 or 32 volts (10-185).
   After the 4 hour period, voltage drops to normal float voltage (13.4 V for 10-184 or 26.8 V for 10-185).
   At this point, shut the system down.
5) ALLOW BATTERIES TO COOL. Check fluid level. Replace vent caps. Re-connect batteries and external loads in preparation for returning to normal operation.
6) RESET THE REGULATOR:
   a) Remove the 2 terminal jumper plug.
   b) Turn the Duty Cycle pot. Screw back to the fully CCW (counter-clockwise) position.

DO'S & DON'TS WHEN INSTALLING & USING AN AQUALINE REGULATOR

The following guidelines will help avoid common application problems and give better performance of your charging system. PLEASE FOLLOW THEM!! If you need technical assistance, call 800 443-9394 or 817-535-0284

1) **DO NOT** power the regulator's A terminal (pin 7 -fused red wire) from a voltage source susceptible to large fluctuation. Do not connect to the starter-especially with an old / under-sized cranking battery. DO power from a house battery
   REASON: Sudden drops in supply voltage during time out or voltage step up can trick the micro-controller into thinking it has seen either a reset of the ignition switch or a short circuit on the field terminal. Either condition will shut down the regulator just When you expect it to bring system voltage up to 14 volts.
   SYMPTOMS: A 2 flash LED signal and/or voltmeter stays at 12 V - two minutes into cycle.
2) **DO NOT** wait until the regulator has timed out (90 seconds) to start the engine.
   REASON: Same as item 1.
3) **BE CAUTIOUS** about connecting Pin 3 (I terminal-Brown wire) to points other than the Ignition key.
   REASON: Voltage on these points may go away during the first 90 seconds of operation. If this happens, the regulator loses Its turn on signal, and the charging system comes on much later than expected.
4) **DO** connect the Remote Sense lead (pin 4- fused Red/white striped wire) directly to your most heavily loaded battery. If you have multiple batteries and a selector switch, connect Sense to the center switch contact, **but** make sure you use large cable between alternator output and selector switch so that voltage drop between them does not exceed 1/4 V. **REASONS:** Regulator will not work unless SENSE is hooked up. Proper connection minimizes alternator "whine".
   You want to optimize charging and life cycle cost of expensive batteries, so It's Important to control actual battery voltage. If you connect to some point that happens to be 2 volts below battery voltage under heavy load (due to line drops), the sense point will be at 14 volts and the battery will be at 16 volts.
5) **DO** use a indicator lamp in the ignition circuit (brown wire). There is less stress on components in the I circuit with a lamp, and the lamp flashes the same error signals as the green LED on the module. Nice to have it where you can see the signals !! Use an incandescent bulb per the specs on page 3.
   DO NOT stop the engine with a "kill" switch and leave the Ignition switch ON for more than 1- 2 minutes.
   REASON: The regulator is left in a full field condition drawing 3) to 5 amps.
6) **DO** use our optional Thermal Probe on a battery that you expect may exceed 120 F case temperature.
   REASON: Charging voltage should be reduced on hot batteries to prevent damage. The Aqualine (with probe) will step down 1/2volt (I volt for 10- 185) above 120 F. The regulator resets to normal voltage when temperature drops below 100 F.
   Please **DO NOT** mount a battery in a hot location (close to the engine, exhaust manifold, or in direct sun), connect a thermal probe, and then complain when the regulator lowers system voltage (and there-by output current) during a high load condition. The regulator will only be doing its job.
7) SET POINT CONFLICT:
   BE CAUTIOUS about operating more than one charging system at a time. A GENSET, wind charger, or solar system can put a voltage higher than the regulator' s, set point on the battery line, If this happens, the Aqualine is satisfied and shuts down the alternator. If the operator sees the ammeter current drop to zero, he may think the alternator has failed. The system will restart when the lgn. Key is cycled. If you must feed a single battery line from multiple sources, adjust all of their regulators to have the same set point, **OR** prioritize them (highest set point for most important source of energy).

TROUBLE-SHOOTING CHARGING SYSTEM PROBLEMS

NO ALTERNATOR OUTPUT

You need to determine if the cause is the alternator, the regulator, or wiring / connection problems.

1) Check all fuses to see if any is blown (In-line fuses in red wire and red/white stripe wire) - a 3 blinkcode.
2) Verify the REMOTE SENSE lead on the regulator is connected to a battery. Reg. will not work if terminal is open.

3)TEST THE ALTERNATOR BY ITSELF (By pass the regulator and force a momentary full field condition)

A) AT THE REGULATOR: Lift the 9 pin plastic connector off the regulator. Have someone start the engine and hold it at a fast idle (1000 RPM diesel / 1500 Gas). Using a jumper wire or a bent paper clip, connect pin 7 (red wire) to Pin 2 (blue F wire) - right into the receptacles of the connector itself If the alternator is good, it will "roar" to life and system voltage will quickly rise to 14-16 volts.

*If this does happen, the regulator (or its wiring) are bad. Replace the connector on the regulator and go to Voltmeter Testing described on page 9 below. If this does not happen, either the alternator is bad or there are wiring / connection problems. Replace the connector on the regulator, and repeat this test at the alternator.

B) AT THE ALTERNATOR

SERIES 23 & 24 ALTERNATORS

Pull the 2 terminal plastic plug (blue & white wires) out of the small "window" in the alternator casing to expose the field and stator spades. Locate the F terminal (blue wire) and use a jumper wire to connect it to battery voltage.

SERIES 25 ALTERNATORS

Locate the PO S Field terminal (F+) on the brush plate (blue wire). Use a jumper wire to connect it to battery voltage.

CAUTIONS:

If the alternator is good, it will "roar" to life and system voltage will quickly rise to 14-16 volts.

*If this does happen, the problem is in the wiring from the regulator to the alternator. Go back and check all wires and connections both visually and with an ohmmeter. If this does not happen, the alternator is bad and will have to be removed for testing (for an open rotor, etc.

1) Hold a jumper wire or paper clip with glove or insulated pliers. If the rotor is shorted, hot wire can burn you
2) A full field test should not be done for more than 5 to 10 seconds. With no regulator, system voltage will just keep rising. More than 16 volts is dangerous and could damage lights or electronic components.

INTERMITTENT OPERATION:

If the charging system seems to work some times but not others, it may be due to bad connections, a shorted rotor (alternator field winding), or electrical transients which are knocking the regulator's micro controller off the air.

1) Check all connections on the regulator, alternator, and battery(s) to make sure they are clean and tight. Check spade terminals and battery posts for corrosion. Clean if necessary. Check all wiring for broken wires or frayed insulation that could result in a wire shorting to other metals (ground). Check the 2 in-line regulator harness fuses.

2) If regulator shows 2 LED blinks, check for shorted rotor. With power OFF, use an ohmmeter to probe from regulator F terminal to GND with all connections in place. Pierce the insulation on the blue wire just above connector. 2 to 5 ohms is good. Less than I ohm indicates a rotor problem. Remove alternator and test. Make this measurement both at rest and while manually turning the alternator (to watch slip ring contact). Ohm reading may vary while turning, but it should not go to zero or to infinity (open circuit). If bad, fix, then try again.

3) If no rotor short is found and 2 blink signal persists: use voltmeters to monitor A and I terminal voltage during entire 3 minute start up cycle. If A terminal drops below 8 volts, the micro controller may be dropping out. If the voltage on the I terminal goes away (even momentarily) after first KEY ON, the regulator is losing its TURN ON signal. Check BATT and IGN source or get more stable power hook ups. SEE DO's and DON'TS SECTION (pg.7).

4) The thermal probe for the battery cannot be plugged into the regulator after IGN switch has been turned ON, or it will create a disturbance that shuts the regulator OFF. Plug it in before applying power and leave it alone.

LOW SYSTEM VOLTAGE: 1) Inadequate battery cable size. Use larger diameter cable on both POS. & GND connections. 2) Wrong pulley ratio. Alt. Speed may be inadequate to deliver required current. System voltage drops rapidly if current is pulled out of the battery. Record alternator model number and engine speed, then measure O.D. of both Alternator & Engine pulley. Then call our Tech Service for help at 800-443-9394 or 317-535-0284.

TEST THE REGULATOR IN THE CIRCUIT - VOLTMETER TESTING.

The following measurements can be made with any hand held voltmeter (analog or digital) and will tell you if the regulator is getting the proper voltages and turn on signals. Make probe connections night at the regulator's terminals.

You can use an insulation piercing clip or cut a bare spot on each wire. The voltmeter's NEG. Lead goes to the GND. wire, and the POS. Lead to the lead shown in the table below. All voltages shown are approximate. Values for a 28 volt regulator are double those shown in the table, except for I terminal with a mode indicator lamp.

FAILURE CODES:

A. Lack of battery voltage at A or SENSE terminals means regulator has no power. Check fuses in red & red / white Wire. If isolator is used, make sure red wire was moved from ALT output to battery terminal.

B. Lack of voltage on I terminal means no turn on signal to regulator. Check connections and continuity of brown wire.

C. No voltage on F terminal means regulator is not producing pedestals. If so, tachometer may not work either. Nothing you can do - return to HPS.

D. If the 5 volts is incorrect, the internal power supply for the micro controller is not working right. If other functions are wrong also, return to HPS.

E. 2-4 volts incorrect may indicate incompatible bulb. If indicator lamp is not lit, regulator may not turn on. Change to a lower resistance bulb per the specs on page 3.

F. Wrong F voltage says regulator did not come on properly after time out. If operation with engine on is incorrect also, return to HPS.

G. If A and SENSE do not step up to 14 volts, either the regulator or alternator are not working.

H. If stator voltage does not come up to 5-7 volts, the alternator is not working.

I. If Field voltage does not increase with load, regulator is not working properly. If LED is flashing a 2 blink code, the field is shorted or the A terminal voltage has dropped below 8 volts.

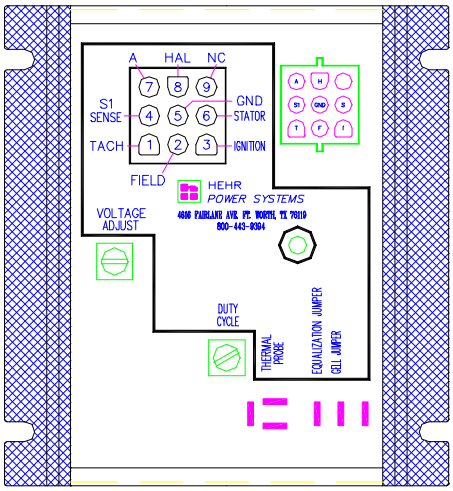
CONDITIONS	VOLTAGE AT SPADE TERMINAL (10-184)						
	Pin 3 I	Pin 7 A	Pin 6 S	Pin 2 F	Pin 4 SENSE	+5V	FAILURE CODES
1) Key OFF, Engine OFF	0	12	0	0	12	0	A
2) Key ON, Engine OFF							
First 90 seconds							
*With Indicator Lamp	2-4	12	0	1	12	5	B, C, D, E
After 90 seconds							
*With Indicator Lamp	2-4	12	0	10-12	12	5	F
3) Key ON, Engine ON							
First 90 Seconds							
*With Indicator Lamp	2-4	12	1-2	1	12	5	
After 2 minutes	14	14	5-7	2-12 **	14	5	G, H, I

** Voltage depends on load conditions (current draw on alternator).
Light load: 1-3 volts
Medium load: 3-6 volts
Heavy load: 7-10 volts

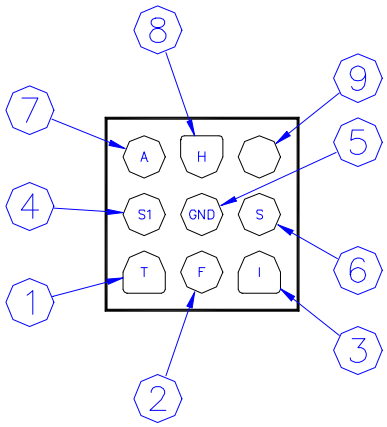
NOTE: Battery voltage readings shown (10-12 volts) will double for the 10-185 model.

FIGURE 1A – CONNECTOR CONFIGURATION – TOP VIEW

REGULATOR MODELS: 10–184 & 10–185

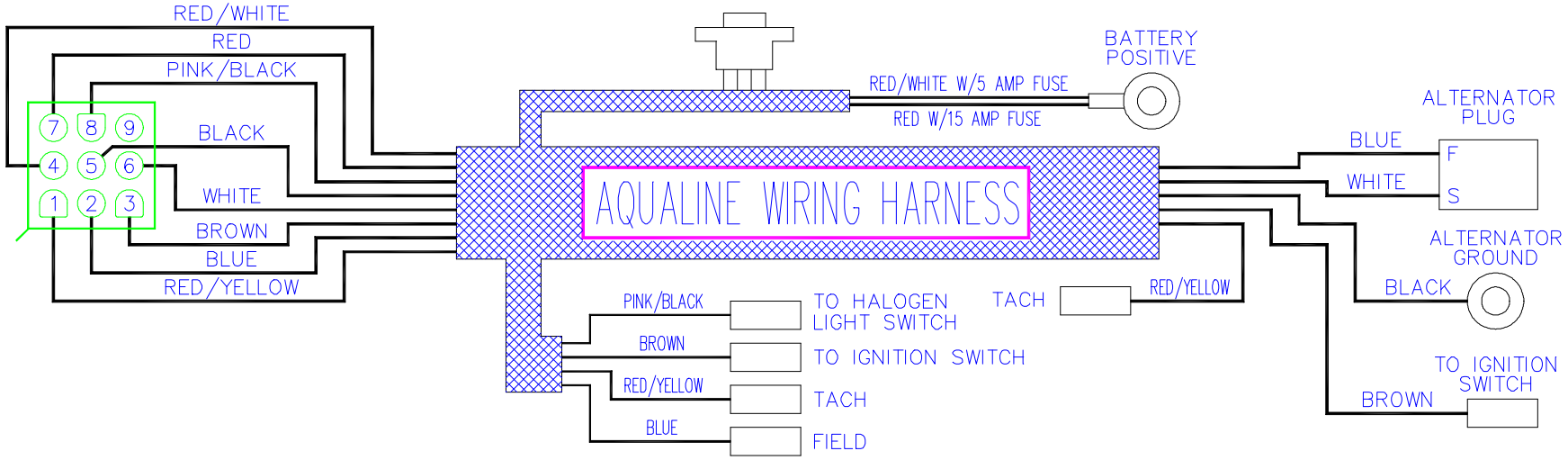


PIN #	NAME	HARNESS WIRE COLOR	FUNCTION	PIN LOCATION
1	TACH	RED/YEL	TACHOMETER OUTPUT	
2	F	BLUE	FIELD OUTPUT	
3	IGN	BROWN	IGNITION TURN ON	
4	S1	RED/WHT	REMOTE SENSE	
5	GND	BLACK	GROUND	
6	S	WHITE	STATOR TURN ON	
7	A	RED	POWER SUPPLY	
8	HAL	PINK/BLK	FROM HALOGEN LIGHT SWITCH	
9	–	WHT PLUG	NO CONNECTION–NOT USED	



REGULATOR SPECIFICATIONS

PARAMETER	14 VOLT MODELS	28 VOLT MODELS
OPERATING TEMPERATURE RANGE	0° F TO +200° F	0° F TO +200° F
STORAGE TEMPERATURE RANGE	–40° F TO +250° F	–40° F TO +250° F
OPERATING BATTERY VOLT RANGE	8 TO 16 VOLTS	16 TO 32 VOLTS
QUIESCENT CURRENT DRAIN	10mA MAX	10ma MAX
SET POINT ADJUSTMENT RANGE	13.7 TO 14.7 VOLTS	27 TO 29 VOLTS
SYSTEM VOLTAGE VARIATION		
* WITH SPEED (@ 10% RATED LOAD)	0.2 VOLTS FROM 2000 TO 8000 RPM	0.2 VOLTS FROM 2000 TO 8000 RPM
* WITH LOAD (10 TO 90% RATED OUTPUT)	0.4 VOLTS MAX AT 4000 RPM/80° F	0.6 VOLTS MAX AT 4000 RPM/80° F



HEHR
POWER SYSTEMS

AQUALINE WIRING HARNESS AS SHIPPED
CONFIGURED FOR A SERIES 23 (SMALL CASE) ALTERNATOR

11-20-98
C-AQU17

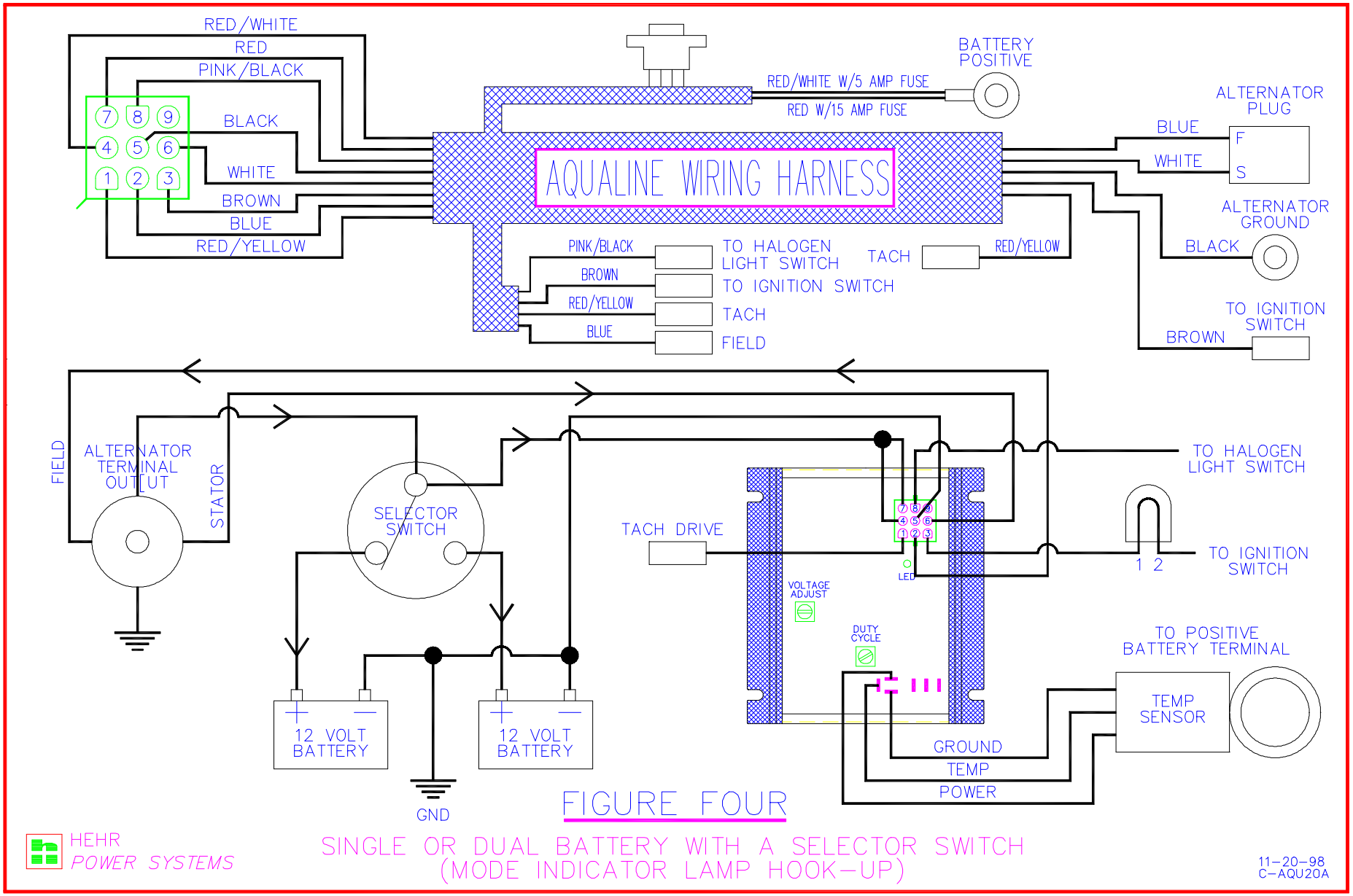


FIGURE FOUR

SINGLE OR DUAL BATTERY WITH A SELECTOR SWITCH (MODE INDICATOR LAMP HOOK-UP)

HEHR *POWER SYSTEMS*

11-20-98
C-AQU20A

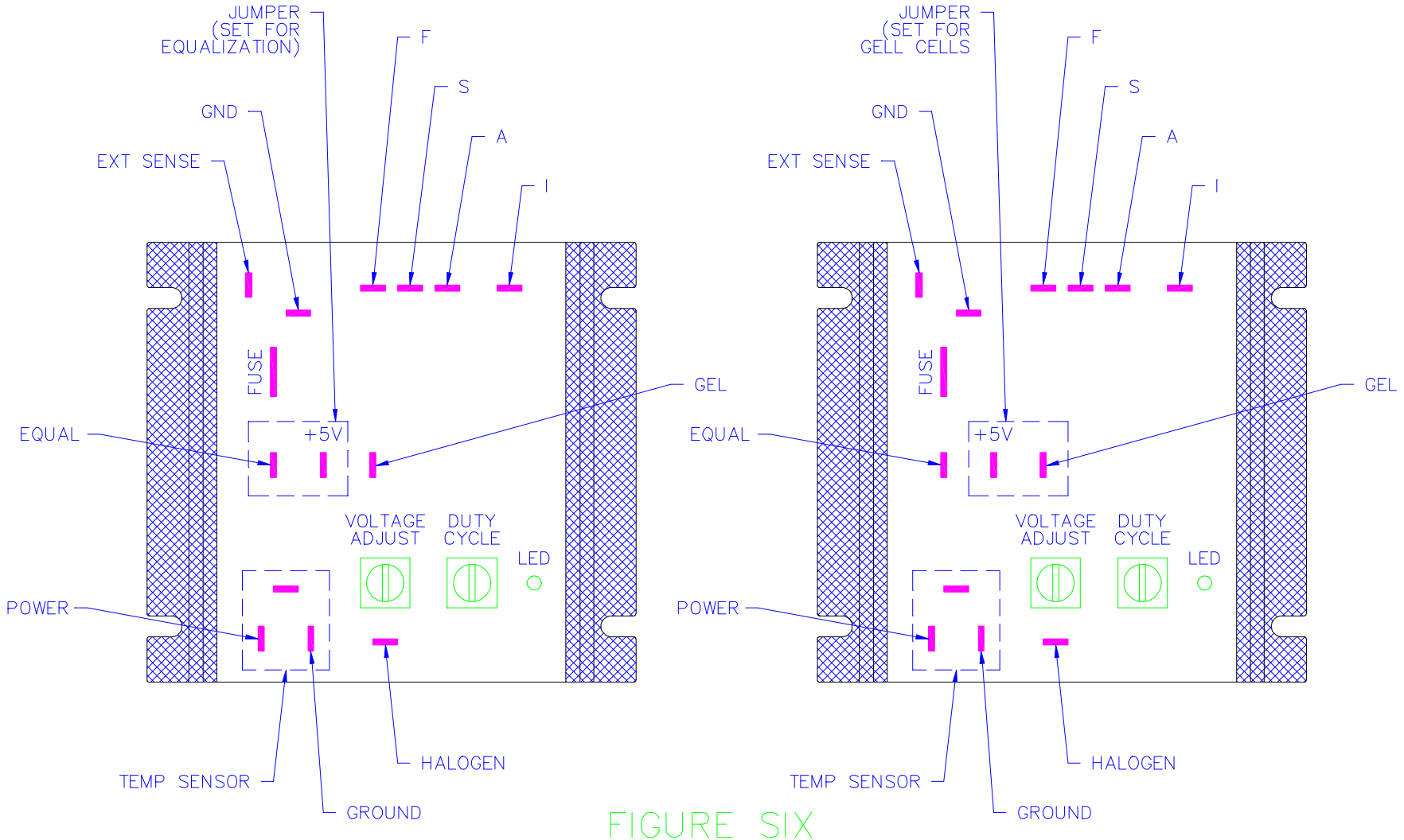


FIGURE SIX

LEAD & JUMPER IDENTIFICATION ON
1996 & 1997 MODEL AQUALINE REGULATORS

HEHR
POWER SYSTEMS

11-20-98
C-AQU25

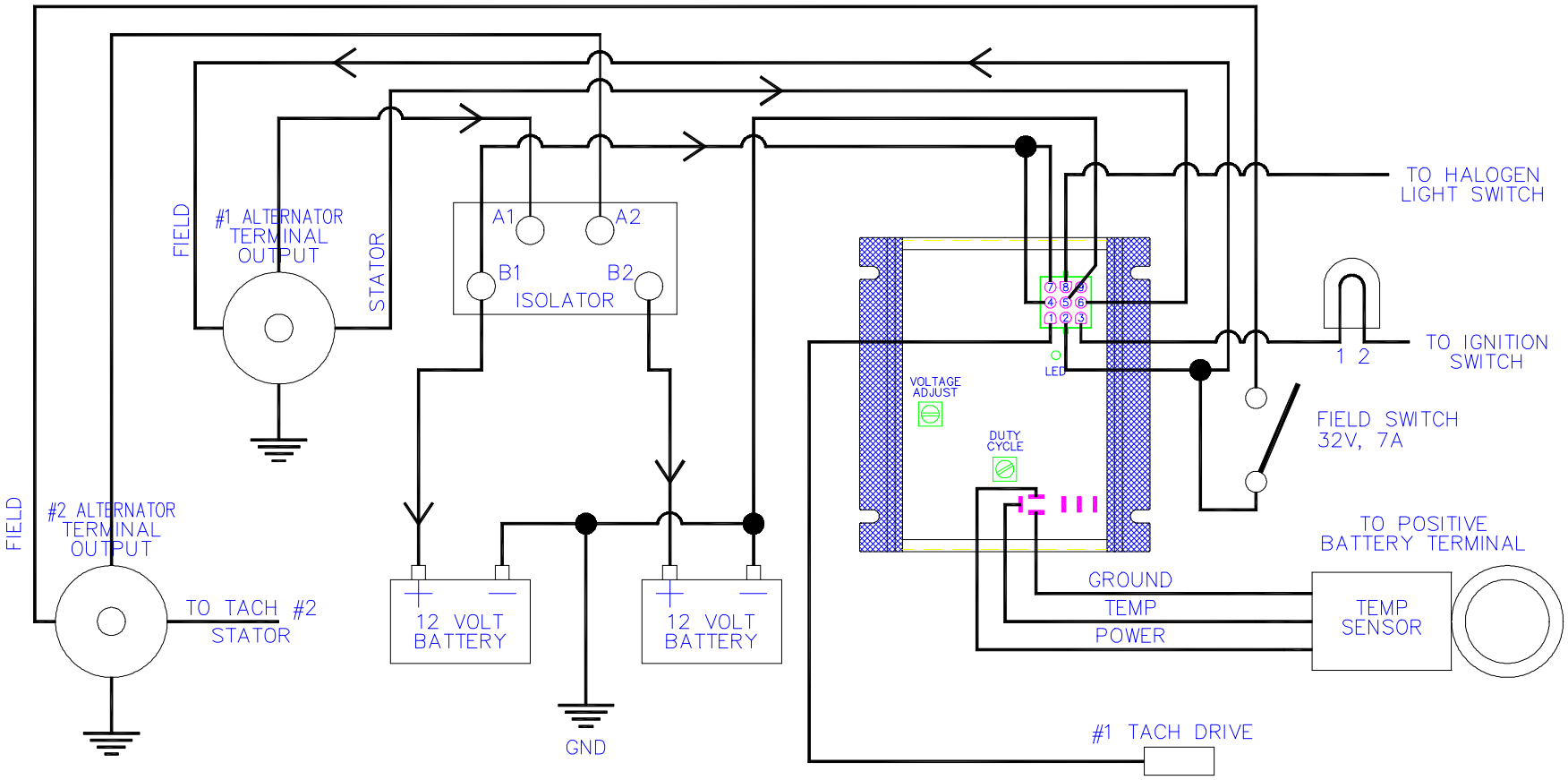


FIGURE SEVEN–A

WIRING DIAGRAM FOR DUAL ALTERNATORS WITH ISOLATOR (MODE INDICATOR LAMP HOOK–UP)

HEHR
POWER SYSTEMS

11–20–98
C–AQU23A

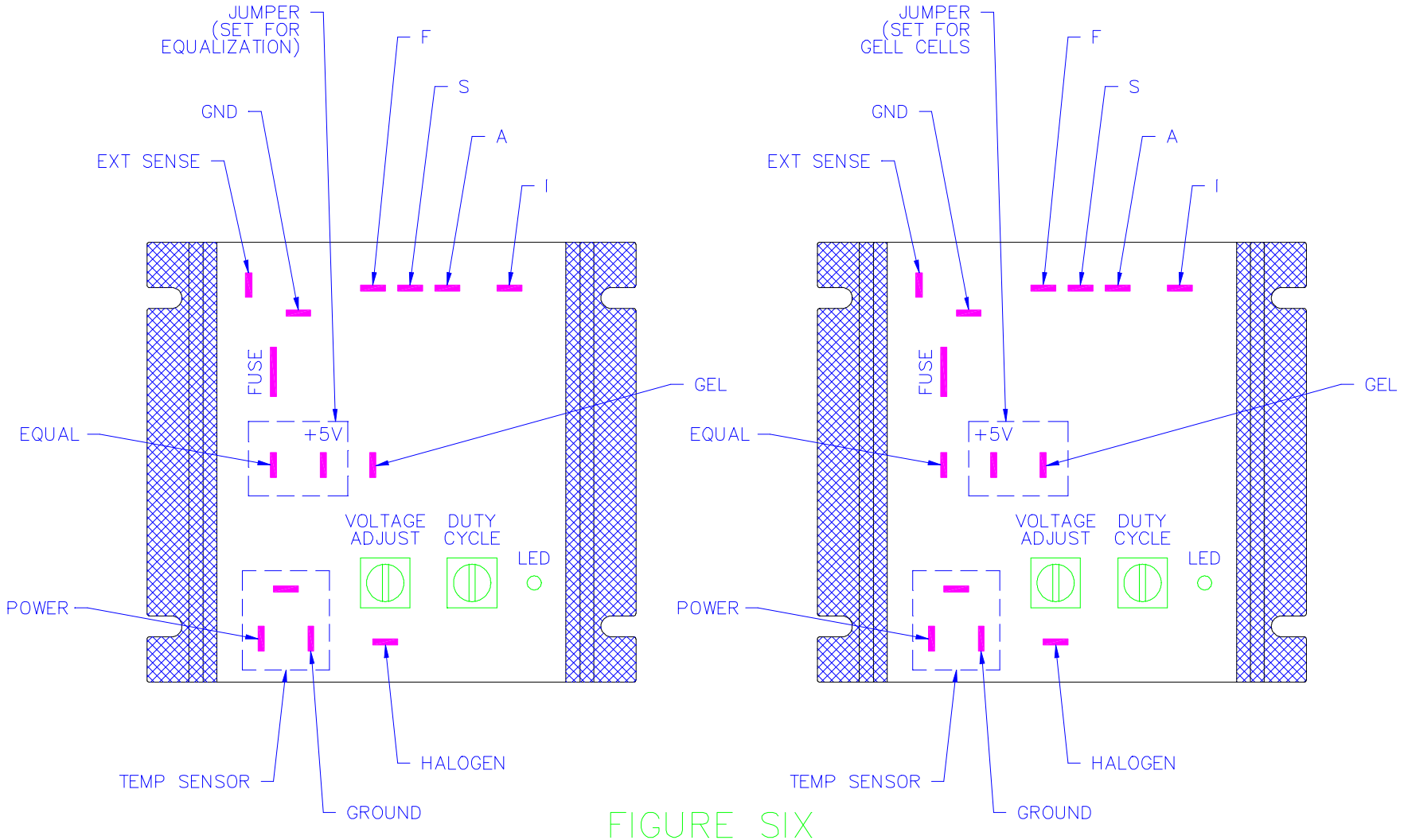


FIGURE SIX

LEAD & JUMPER IDENTIFICATION ON
1996 & 1997 MODEL AQUALINE REGULATORS

HEHR
POWER SYSTEMS

11-20-98
C-AQU25