How To Guide: Installing A Sterling Advanced Regulator (PDAR)

Introduction

There's been lots of chatter on the forum about the pro's and con's of installing external alternator regulators. After treating my battery's with a “carefree attitude” I decided to install one of these units to examine the performance improvement that it would give to a new replacement set of “wet” lead acid battery's.

I brought the PDAR unit instead of the DAR12 unit as it could in the future have the remote control/information panel installed and the price difference is not great – there are also additional features such as the temperature sensors – see the Sterling website for information. http://www.sterling-power.com/products-altreg.htm

The unit was installed on Saturday 23rd February 2008.

Disclaimer

This guide is intended to demonstrate how I installed the unit, following the instructions manual and suggestions by fellow forum members. It is not intended as a best practise guide or to demonstrate my electronic ability. If you intend to install a similar unit on your boat, it is your responsibility to understand your boat electrics, your electrical capability and your ability to understand and follow the instructions.

If you damage the unit, your boat, its components or yourself, don't blame me! No liability is intended or implied.

The Boat

A 2005 model 45ft Liverpool “sailaway” narrow boat. Cruiser stern style, fitted with Isuzu 35LB1 engine with twin Isuzu 70A alternators (Lucas type). I have 3x 110A standard wet lead acid battery's.

I do not have a split charge system, bow thruster or charging relay as each alternator drives its own battery bank.

I have an installed and working Smartgauge unit, and a 100A shunt type Ammeter installed.

Ammeter

The Ammeter I have installed previously is a cheap e-bay unit from http://stores.ebay.co.uk/new2006power-DigitalWorld_W0QQssPageNameZstrkQ3amefsQ3amesstQQtZkm

You will need the meter and a shunt like these.

- http://cgi.ebay.co.uk/100A-dc-Green-Led-Digital-Panel-Amp-Meter-w-REGULATOR_W0QQitemZ150216945577QQihZ005QQcategoryZ46412QQcmdZViewItemQQ_trksidZp1742.m153.l1262
- http://cgi.ebay.co.uk/SHUNT-for-DC-100A-75mV-Current-Meter-Ampmeter-Ammeter_W0QQitemZ160207325846QQihZ006QQcategoryZ25411QQcmdZViewItemQQ_trksidZp1742.m153.l1262

Generally the complete unit can be installed for about £25. Ensure that 100A is enough to cope with your power requirements especially if you have a large inverter.

Installation of the ammeter is outside the scope of this guide.

Things You Will Need Before You Begin

- Digital Advanced Alternator Regulator – PDAR - http://www.sterling-power.com/products-altreg.htm
- Install instructions supplied in the box (in very small writing) and available here to print yourself http://www.sterling-power.com/images/downloads/PDAR_%20A5_2006a.pdf
- Multimeter (for measuring continuity and voltage) - with a good degree of accuracy less than 0.5% (I use the installed SmartGauge which has accuracy of 0.3%)
- Very useful and highly recommended – Ammeter installed onto the domestic battery bank. This allows you to easily see the improvement in charge rate the new alternator regulator will provide.
- 7/32” socket for removal of existing alternator regulator (for Isuzu/Lucas alternators)
- 2.5mm^2 white wire – about half metre for connection inside your alternator.
- 2.5mm^2 Yellow wire for connection to your ignition switch – this needs to be long enough to connect the PDAR and your ignition switch together – I used about 3 metres.
- Suitable place to mount the PDAR unit securely in a dry location as close to the alternator as possible so that you don't need to extend the cables. (you can extend the cables that run to the battery and ignition switch)
- 4x screws to attach the PDAR to your chosen mounting place
- 12mm plastic spiral cable wrap (or similar) (like this http://www.maplin.co.uk/module.aspx?ModuleNo=26849&doy=24m2)
- Various sized plastic cable ties (like this http://www.maplin.co.uk/Module.aspx?ModuleNo=6229&criteria=wrap&doy=24m2)
- Male and female spade type INSULATED crimp connectors (blue sizing) (like this http://www.screwfix.com/prods/90867/Electrical/Cable-Accessories/Crimps/Crimp-Blue-Female-6-3mm)
- A proper crimping tool (like this http://www.screwfix.com/prods/70036/Hand-Tools/Forge-Steel/Pliers-Cutters/Crimpers/Forge-Steel-Ratchet-Crimping-Tool)

Once you have dismantled the alternator and determined what type of material the connection terminals are you may also need:

If the existing alternator regulator has stainless steel connections:

- Suitable drill bits from 1.5mm to 3.2mm.
- A tiny 3mm bolt with nuts and thread lock “glue” (you may instead use a very small self tapping screw)

If the existing alternator regulator has copper connections:

- A large wattage soldering iron and suitable solder.

Inside the box

There are 3 items inside the box:

- The PDAR unit with pre-connected cables
- 2 temperature sensors
- Instruction manual

Step 1 – Tidy and identify cables

I took the opportunity to tidy the cables from the PDAR unit before I started installation. Using the spiral wrap I made two bunches of cables, one will go towards the alternator and the other towards the battery. You will also need to include one temperature sensor in each bunch of cables (the ring terminal goes at the point furthest away from the PDAR unit)

Bunch 1 (towards battery)

- Temperature sensor
- Yellow – ignition switch +12v when engine is running.
- Black / White strip – battery bank negative
- Red – battery bank positive.

Bunch 2 (towards alternator)

- Temperature sensor
- White – internal alternator connection.
- Brown – alternator “lamp” connection (marked ING on my alternator)
- Black (2 wires) – alternator negative (connected to alternator case)

Step 2 – Set DIP switches

Open the cover on the PDAR unit to expose the small DIP switches, change these to match your battery bank type. Refer to the manual for the correct settings to do this.

Also notice the two terminals that you will use to connect the temperature sensors – you need to do this later on once you know the correct length of the cables.

Temporally replace the cover to prevent damage to the circuit board whilst installing.

Step 3 – Fix the unit to a bulkhead

Mount the PDAR unit using 4 screws to a bulkhead near the engine alternators and battery bank. Its important to mount the unit nearer to the alternators that it is to the battery bank as the battery bank cables can be extended. Be careful to ensure that the area is dry and rain cannot drip into the unit if you need to remove deck boards or hatches.

Make sure the cables easily reach the rear of the alternator without stretching or fouling the belts/pipes and other cabling in the area. I found it best to follow the same route as the positive/negative cables from the alternator to the battery bank – as you can then cable tie the PDAR cables to the existing cables.

Step 4 – Ignition switch connection

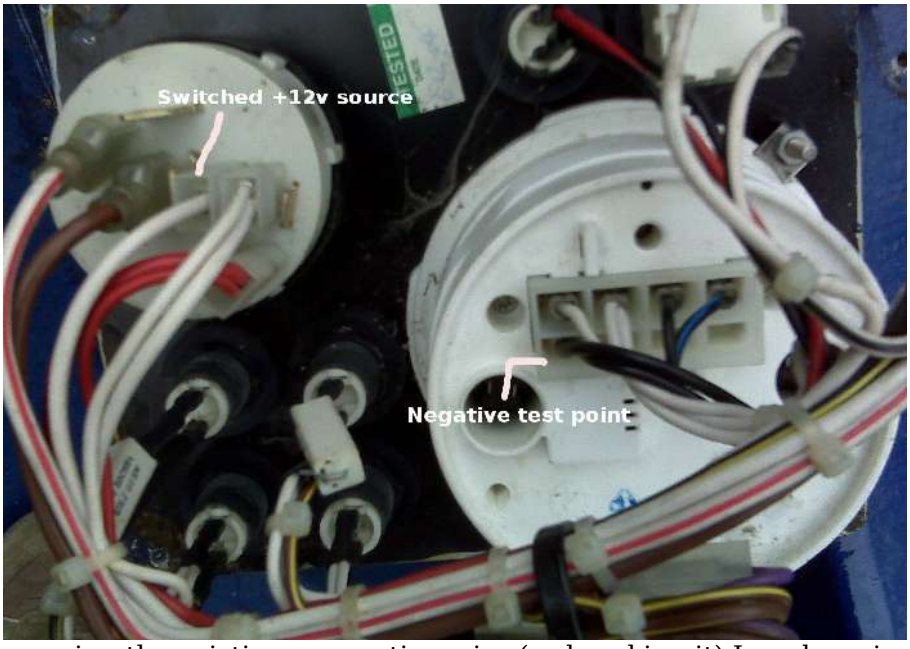
The PDAR unit needs to know when the ignition is switched on, to do this you need to identify as +12V connection that is live only when the engine is running. This point needs to be connected to the yellow PDAR wire.

On my Isuzu engine I didn't have a existing switch connection so I identified one on the control panel. Remove the four screws holding the panel to the boat and turn the panel upside down making sure that none of the cables touch the bare metal hull.

The ignition switch is the smaller white circle shown on this picture. The +12v source I identified is the spade connector with a single white wire coming from it.

To check this place a multimeter negative (black) probe onto the 2 black cables entering the rev. counter and the positive probe onto the white cable identified in the picture. You should be able to push the probes into the back of the crimp terminals. Make sure the multimeter is set to read voltage (probably 0-20v scale).

With the engine switched off you should have a reading of 0v. Start the engine and the reading should be 12v. Stop the engine (and turn key to off) and the reading will return to zero.



Rather than damaging the existing connection wire (or breaking it) I made a simple “Y” type connector using crimp terminals.

Remove the existing white wire by gently pulling it off the ignition switch, replace with the “Y” connector like the photo below. Connect the white wire back to one side of the “Y” connector and to the other spare connector connect your long Yellow wire. You can use insulation tape and/or heat shrink tubing to secure the crimp terminals so they don't separate due to engine vibration.

Run this Yellow wire safely down from the ignition switch to the yellow cable coming out of the PDAR unit. Make sure the cable wont get trapped inside doors, hatches etc. and also ensure that the cable cannot chaff against steel edges – ideally run this through conduit or some additional spiral cable wrap.

Connect to the PDAR yellow cable using another crimp terminal (this can be a solid jointing connector rather than spade type) – alternatively solder the two together and cover with heat shrink tubing.

Step 5 – Alternator Removal

The alternator is surprisingly easy to remove from the Isuzu engine.

Make a note of where the 3 existing cables are connected to (take a photo?)

Next squeeze the rubber V belt running to the alternator together and measure the gap in the middle – make a note of this so you can get the same tension when refitting.

- Remove all cables
- Remove the top bolt (watch the washer doesn't drop inside the alternator)
- Push the alternator towards the engine to slacken the V belt. You may need to undo the accelerator morse cable to do this.
- Remove V belt
- Unscrew the allen bolt at the bottom of the alternator. This is held in with two spring type washers at each end so make sure you don't loose these.
- Once removed, make a note of where the bolts, washers and springs all go to aid re-fitting.

Step 6 – Alternator Regulator Removal

Note: These instructions are for the Isuzu/Lucas alternator fitted to my boat – yours may be different!

This is a difficult part to remove as the bolts are a small size and inset into the top of the regulator. The bolts heads are 7/32” in size.

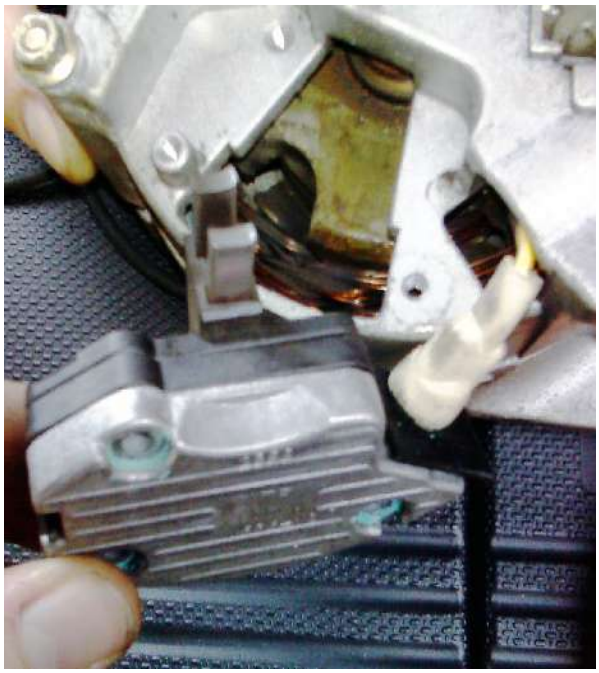
The regulator is located in the bottom of this picture held in with 3 bolts with blue thread lock covering them.

To remove these I needed to use a great deal of force with a pair of needle nose pliers to get a couple of turns on the bolts (and break the glue) – then get a socket onto unscrew the remaining thread.

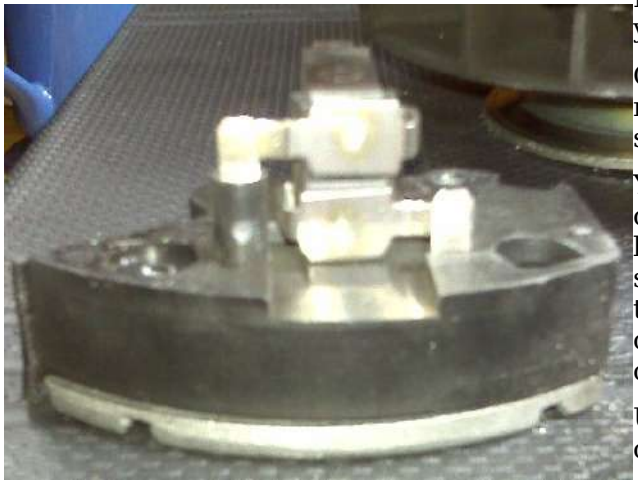
Once all 3 bolts are removed you need to carefully remove the regulator. It is important that you are VERY gentle with the removal otherwise you may damage the brushes and this will mean buying a replacement standard regulator.

Carefully lift the regulator up from the left hand side (with it facing you) and pull it towards you so the brushes come out intact.

There will be a small wire on the right hand side which you can unplug from the regulator.



Step 7 – Alternator Regulator Modification



Place the regulator upside down on a table so you can see the rear of the two brushes.

On this alternator the connection point you need is on the bottom right, the small tab sticking out of the black plastic.

You can verify this by using a multimeter on continuity test, connect one probe to the top left brush connector and the other probe to the spade terminal where the regulator attached to the alternator cable. This should create a circuit – you want the OTHER terminal not this one!

Unfortunately my regulator terminals are made of stainless steel which is difficult to solder to.

Following advise on the CW forum I decided to attempt to drill and bolt a connector to the regulator instead. To do this I used a 1.5mm drill bit to drill through the centre of the metal lug, slowly building up to a 3.2mm drill/hole.

If your regulator connections are made of copper, it is easier to solder a connection to this terminal and will probably give less chance of shorting against the casing of the alternator.

I used a very small bolt and nut to attach a crimp connector. I found even the smallest ring terminals were too large, so chose to carefully drill a 3.2mm hole in the centre of a male spade connector and then bolted this to the lug using thread lock and a locking nut to ensure that it wont come loose. Connect the white wire to the spade terminal before bolting on!

Its critical that the terminal does not protrude very much so that there is no chance of the terminal/bolts/crimp connecting with the case

of the alternator.

Check the connection again using a multimeter, check that there is NO continuity between the wire you have attached and the existing spade terminal on the regulator.

If all is well, coil up some of the white wire near to the regulator so take some slack, cut the wire about 20cm long and crimp a female spade connector onto it.

That's the tricky part over!

Step 8 – Alternator Re-assembly

The regulator needs to be inserted back into the alternator, make sure you connect the existing wire between the alternator and the regulator.

You will need to be VERY CAREFUL when inserting the regulator so that you don't break the brushes. If you do you will need a replacement regulator.

The regulator will drop in if its at the correct angle don't use any force just wiggle it until it drops in. Make sure your new cable is not trapped between the casing and the regulator. Check e-bay sites if you do damage it – replacements around £10!

Due to the difficulty in removing the regulator bolts I decided to add some washers to the bolts to make reassembly easier, this means that the bolts stick slightly proud of the regulator and a standard socket will fit and tighten easily. I also used some thread lock.

Using a multimeter check there is NO continuity between the case of the alternator and the white cable. Also check that there IS continuity between the white cable and the “ING” spade terminal on the alternator.

You have now completed the alternator modification – time to put it back onto the engine!

Fitting is the reverse of removal, attach the bottom bolt first. Attach the V belt and then fit the top bolt (loosely).

Tension the alternator belt by moving the alternator away from the engine (get someone to help with this) and then tighten the top bolt when correct tension is found. Take care if using leverage that you don't damage any components on the engine.

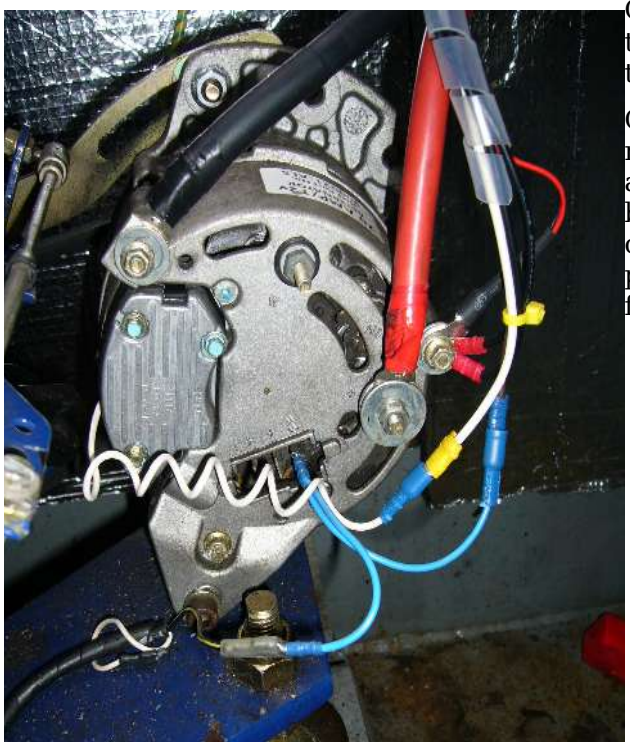
Reconnect the three existing wires (negative/positive and indicator lamp) making sure the positive is clear of the alternator casing and negative leads.

Step 9 – Testing alternator

1. Double check your connections to the alternator.
2. Take a voltage measurement at the domestic battery bank
3. Start the engine normally
4. Ensure that all engine warning lights go out (oil/battery etc.)

5. The PDAR unit WONT light up at this stage!
6. Take a voltage measurement at the domestic battery bank – it should be much higher than before.
7. If you have an ammeter ensure that the reading is showing charge being put into the battery's (the amount will depend upon existing battery condition).
8. If everything is okay, stop the engine

Step 10 – Completing electrical installation



Connect the remaining wires of the PDAR unit to the relevant terminals on the battery bank and the alternator.

Connect the two temperature sensors to the negative terminal on the battery bank and alternator. There is no electrical connection between the ring terminal and the sensor but connecting to the negative will help prevent potential short-circuit hazards occurring in the future.

- Yellow wire – already connected to the PDAR and ignition switch.
- White wire – connect this to the new white wire on the alternator. You may wish to fit an in-line fuse to this – 10A rating. Fit one with spade terminals for ease.
- Brown wire – connect this to the small indicator wire already on the alternator. I used another “Y” connector to do this instead of damaging the existing cable – shown as the blue cable in the picture.
- Two Black wires – connect both of these to the alternators case using the nuts on the back of the case.
- Black / White Stripe – connect using a large (8/10mm hole) ring crimp connector DIRECTLY to the negative battery terminal.
- Red – connect using a large (8/10mm hole) ring crimp connector DIRECTLY to the positive battery terminal. This wire will need to be connected to a different location if you are using a split charge system – refer to the installation manual.
- Temperature sensors, trim off excess wire (leave a little slack) and connect the wires to the two screw terminals inside the PDAR unit (remove the cover) make sure you get the correct terminal (marked in small writing on the circuit board). It doesn't matter which way around the cables go.
- Secure the PDAR case/lid together again using all 8 screws.
- Secure the cable looms using cable clips/ties and ensure they don't foul any belts/pipes and other cables.

Step 11 – Testing the PDAR unit

Double and triple check your connections are as they should be – check with the installation manual rather than this guide !

- Start the engine as usual.
- The battery type L.E.D. will indicate the selected battery type yellow=wet lead acid.
- Yellow L.E.D. will indicate a 12V system.

- The green boost light will flash on start up. (My green flashing L.E.D switched to solid after approx. 15 seconds rather than the 2 minutes it states in the manual)

If there are any other lights on – **STOP THE ENGINE IMMEDIATELY** and check your wiring.

With your voltmeter check if the voltage at the domestic battery bank rises to the maximum absorption voltage as determined by the selected battery type (14.8V for standard wet lead acid).

This can take between one minute and many hours, depending on the size and the state of the battery banks.

I used the Smartgauge and Ammeter to monitor progress of the charging system. The advanced regulator only kicks in when the existing alternator regulator reaches it maximum output (approx. 14.25v) the voltage should then continue to rise until it gets to 14.8V. This will take a while. The voltage may vary slightly on different alternators or regulators, i.e. +/- 0.1V.

You should also notice that the Ammeter reading is higher (possibly double) any readings you had before.

Summary

My boat's battery's are not in a great state, however when running with the standard alternator regulator, the maximum charge is about 50A for a minute after the engine is first switched on. This drops rapidly to 10A in a few minutes.

With the Sterling advanced regulator, the charge stays at well over 40A for a long time whilst if charges the battery, the voltage can be seen to rise from 13v to 14.25v then finally to 14.8v during the charge. If the “white” wire is disconnected whilst the engine is running the existing alternator regulator kicks back in and the current and voltage rapidly drop to their previous readings.

With the advanced regulator running....

At 13.90v the alternator generated 31.9A

At 14.60v the alternator generated 44.1A

At 14.65v the alternator generated 45.9A