

**PENNTEx FOUR-STEP CHARGING SYSTEM TEST AND GENERAL INFORMATION
WITH A PX-4000, PX-5000, OR PX-6000 VOLTAGE REGULATOR
(IF YOU HAVE A 2009-UP FORD WITH A PX-7000 REGULATOR THIS INFO DOESN'T APPLY)**

PennTex Industries, Inc. is a manufacturer of Heavy Duty Charging Systems, High Idler Devices, and Charging System Monitors. Parts are available nationwide through our network of Warehouse Distributors. This information refers to PennTex 14-volt model charging systems with a PX-4000, PX-5000 or PX-6000 Voltage Regulator. For other PennTex systems contact us or refer to our web site at www.penntexusa.com.

All PennTex charging systems use an external voltage regulator. They are usually mounted inside the body of the vehicle under the right side of the dash away from moisture and heat. To be sure of the regulator location, follow the charging system harness from the alternator to the regulator. It will be a maximum of 72 inches away because that's how long the harness is. There will be a white or tan pass-through conduit on the charging system harness at the firewall. If the regulator is mounted in the engine compartment have the connection-side facing down.

All wire colors mentioned here are PennTex charging system wire harness colors. Check these PennTex harness items first: BLACK (ground): check for loose or corroded connections at the engine and the regulator. Ohms on the ground connection should be ZERO. **It is recommended that the BLACK regulator ground wire at the regulator be shortened to 18 inches, a ring terminal added, and attached to a good ground location near the regulator, independent of the alternator ground.**

BLUE (field) & ORANGE (stator): if possible, inspect or actually pull the harness T-connector out of the brush holder and inspect the two terminals. Look for corrosion and be sure that one of the terminals isn't bent over. Plug the T-connector back in. Check for loose cables or discoloration at the large alternator posts and repair as required. Inspect the regulator for corrosion or water damage. Look for burned fusible links. Check to see if the system will charge now.

Use the **PennTex Four-Step Charging System Test Form & Full Field Test Form** to check the system condition. For the four-step test, check the system voltages at the regulator connector, with the connector still plugged in. The readings must be taken at the regulator, not at the alternator. BLUE: rotor voltage, ORANGE: stator voltage, RED: battery voltage, BROWN: regulator exciter voltage usually through the OEM indicator lamp circuit. Get the battery voltage right at the batteries during each step. A difference in voltage readings between the batteries might uncover a problem. All of these tests rely on the ground connections being in good condition. For a second opinion on the voltage readings, fax the test results to 817-590-0398.

During the **first** test, the RED wire will show battery voltage. The regulator is tied to the battery at all times through this wire. The other wires should show zero volts or a few millivolts. Note: a few bus companies wire the system through a main shut-off switch so there's no voltage on the RED wire with the key off. Voltage on the BLUE wire could indicate an open rotor or worn-out brushes. Voltage on the ORANGE wire might be a diode problem. Voltage on the BROWN wire on the first test means the regulator has power to it all the time, and that causes a battery drain. This is a connection problem that needs to be fixed because the BROWN wire should only have voltage on it with the key on. The battery voltage should be the same as the RED wire voltage, or very close. A bad ground can cause intermittent charging. Make sure the voltage regulator case is securely mounted, and that you've shortened the BLACK ground wire to 18 inches.

During the **second** test with the key on and the engine not running, there should be at least 2 volts on the BROWN wire. Turning the ignition switch on sends power to the BROWN wire, and the regulator then connects the RED and BLUE wires together. Zero volts on the BROWN wire indicate a blown fuse (Gauges fuse usually) or an open circuit in the wire that turns the regulator on. If there's no voltage on the BROWN wire with the key on, the system will not charge. The BLUE wire voltage should be about one-half volt less than the RED wire voltage. The BLUE wire is sending voltage to the rotor and magnetizing it. The RED wire will again show battery voltage and be slightly less than in the previous test because of electrical system demand. If there is more than a one-volt difference between the voltages on the RED wire on the first and second tests, you may have a battery condition problem. Charge the batteries for 45 minutes and rerun the test. The ORANGE wire should show no voltage because the rotor isn't spinning and producing electrical power. Voltage on the ORANGE wire on the second test may indicate diode problems. A bad diode will show voltage on the ORANGE wire, usually on both the first and second test, even if the voltage on the ORANGE on the third test is normal. There may also be an overnight draw on the battery with one or more bad diodes. NOTE: on some late model Chrysler products, only the RED wire will have battery voltage on it on the first and second tests. The third and fourth tests will have voltages on the four wires like other systems.

During the **third** test, have the engine running at idle with all accessories off. The BROWN wire will have somewhere between 2 and 13 volts on it. If there's no voltage on the BROWN wire with the engine running, the system will not charge. At idle, the rotor is turning and the stator will put out AC

voltage to the ORANGE wire coming back to the regulator from the alternator. Ideally, the ORANGE wire will have exactly half the voltage of the RED wire. If the ORANGE wire has 1 or 2 volts less than half the voltage of the RED wire, there is a possible stator problem. If the ORANGE wire has close to zero volts, there may be an open rotor or worn-out brushes. If this is the case, there may also be battery voltage on the BLUE wire on the first test. If there is voltage on the BLUE wire on the first test, in addition to very low voltage on the ORANGE wire on the third test, that's another indicator of a loss of field continuity from a possible rotor or brush problem. **IMPORTANT:** if the ORANGE wire voltage multiplied by 2 is even a little more than the RED wire voltage, there's a connection problem with the main output cable of the alternator. This could be a loose connection, a burned output post, or other wiring problem. Check for loose connections and continuity on the ORANGE and BLUE wires between the alternator and the regulator.

The BLUE wire voltage during the third test is an indication of how hard the alternator is charging. This reading may fluctuate up and down, so set your meter to "average". If the BLUE wire voltage is close to zero, you may have a rotor or brush problem. If the BLUE wire voltage is 3 to 8 volts, the alternator is working at low output. If the BLUE wire voltage is at 10 volts or above, the alternator is working at high output to keep up with charging system demand. A discharged or defective battery could cause this. One dead battery cell can cause a great amperage load. Some Ford auxiliary batteries are mounted underneath on the frame. Because of the work involved with dropping them down for inspection, some don't get regularly checked. Load test with a battery tester capable of testing large truck batteries. Smaller hand-held testers will not be as accurate, but are better than nothing. We recommend testing the batteries one at a time with any connections between the batteries removed to be sure of an accurate test. There could also be a bad battery isolator. Do a voltage drop test to confirm this. Some isolators can drop as much as one volt between the in & out connections and still be good.

The **Fourth** test should be done at about 1000 engine RPM. If the system starts charging now, you have a low engine idle RPM issue or it could be that the vehicle electrical system requirements exceed the output of the charging system. It's believed that charging system demand increases by 15% per year due to corrosion, loose connections, and resistance built up in circuits. Make sure that the normal vehicle idle speed is 700-750 RPM in gear with the AC system on. The red light on the dash may be coming on at idle simply because the engine idle speed is too low. 50 or 100 RPM can be the difference in alternator output at idle.

If there is no or very low voltage on the both BLUE and ORANGE wires, check the BLACK ground wire that should now be connected inside the vehicle near the regulator. If the ground is okay, do a Full-Field Test to see if the alternator will charge unregulated. (**Full-Field Test:** disconnect the 4-wire connector at the regulator and jumper the BLUE and RED wires together in the connector. Start the vehicle and let it run for no longer than 30 seconds while checking the voltage at the jumper wire. If the voltage stays the same, you have an alternator problem. If the voltage goes up, you have a regulator problem.)

It is really not unusual for a bus to be built with an electrical system demand as much as the alternator output at idle. When the bus was built, the specification might have called for a smaller alternator to save money. The problem is that the smaller alternator has to work harder. This produces more heat and reduces alternator life. Adding extra batteries to a charging system that isn't producing enough amperage will not fix the problem. Alternator output has to exceed demand.

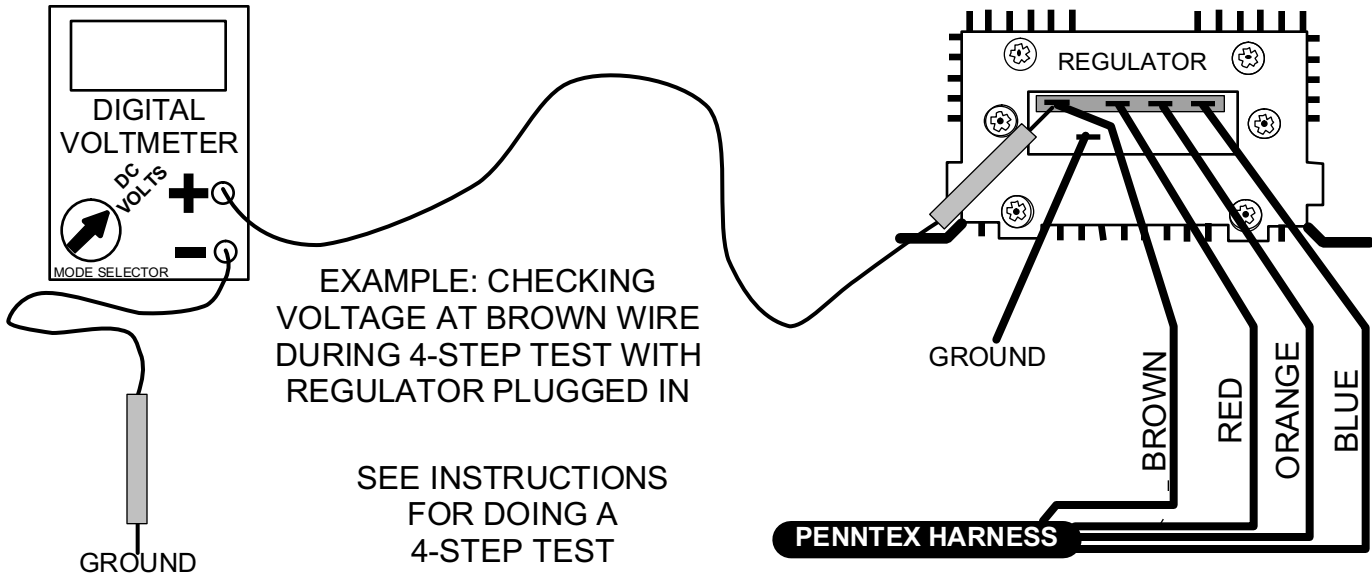
Do a **Voltage Drop Test** using a voltmeter. Compare the voltage at each connection from the alternator to the batteries looking for a significant drop in voltage through the connections. The drop could come from loose connections or corrosion. Check the BLACK ground connections too.

SPECIAL NOTE: Until October of 2005, all PX-5 PennTex alternators had one positive and one negative connection post. PX-5 alternators built after October 2005 have TWO positive posts. BE SURE to properly identify the type of alternator you are installing. There isn't much visible difference. If your PX-5 model number has a "D" in it, such as PX-5TD, PX-520TD, PX-520GD, PX-5GD, PX-5RD, PX-520RD, etc., you have a PennTex alternator with two positive posts. Only a dual positive post PX-5 will have six negative diodes installed in the rear alternator housing with a bridge connector between the posts.

On a dual positive post PX-5, positive cables can be connected to either post. **DO NOT** remove the jumper between the posts. Connect any ground cables to a good ground on the engine. The only PennTex alternators changed to this dual positive post feature are the PX-5 models. PX-2 & PX-4 models still have one positive and one negative post. See instructions enclosed with your alternator for specific hookup information. If you aren't sure which model you have, get your new alternator serial number and call PennTex at 877-590-7366.

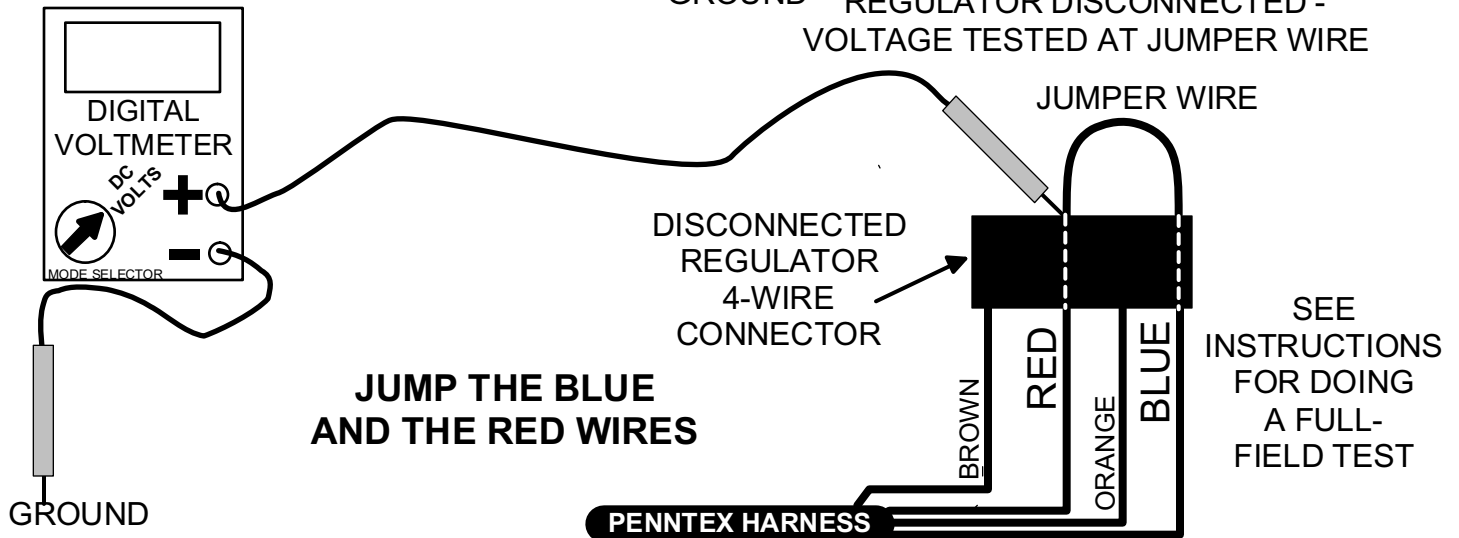
4-STEP & FULL-FIELD TEST BASIC INFORMATION

THE FOUR-STEP TEST IS DONE WITH EVERYTHING PLUGGED IN



THE FULL-FIELD TEST IS DONE AT THE REGULATOR 4-WIRE CONNECTOR WITH IT DISCONNECTED FROM THE REGULATOR

NO VOLTAGE TESTS ARE DONE AT THE DISCONNECTED REGULATOR AT ANY TIME



CHARGING SYSTEM TEST FOR VEHICLES WITH A PX-4000, PX-5000, OR PX-6000 REGULATOR

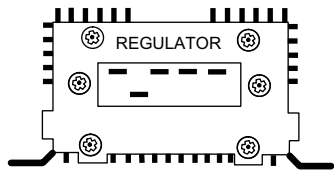


Technical Support Toll Free 1-877-590-7366
 Technical Support Fax 1-817-590-0398
 Parts are available from our Distributors
 See listings on www.penntexusa.com

Contact Name _____
 Phone _____ Ext. _____
 Fax _____
 Testers Name _____
 Alternator Model # _____
 Alternator Serial # _____
 Regulator Model # _____
 Regulator Serial # _____
 Vehicle Mileage _____
 Vehicle Year _____ Make _____ Engine _____
 Vehicle In-Service Date: _____

Describe your charging system problem:

IF YOUR PENNTEX REGULATOR HAS DIFFERENT CONNECTIONS THAN THIS, USE TESTS FOR A PX-7000 REGULATOR.



Locate the external voltage regulator, make sure that everything is properly connected and that the regulator has a good ground. Complete the following chart using a digital voltmeter.

<u>Regulator Terminals</u> ↓	<u>Test # 1</u> Ignition Off Engine Off	<u>Test #2</u> Ignition On Engine Off	<u>Test # 3</u> Ignition On Engine On	<u>Test #4</u> Engine On High Idle
Field Terminal (Blue Wire) "F"	_____volts	_____volts	_____volts	_____volts
Stator Terminal (Orange Wire) "S"	_____volts	_____volts	_____volts	_____volts
Sense Terminal (Red Wire) "A"	_____volts	_____volts	_____volts	_____volts
Ignition Terminal (Brown Wire)	_____volts	_____volts	_____volts	_____volts
Battery Terminal	_____volts	_____volts	_____volts	_____volts

TEST WITH EVERYTHING PLUGGED IN

Ground Terminal:
_____ohms

of Batteries:

Engine Idle :
_____rpm

Engine High Idle:
_____rpm

DID YOU DO A FULL-FIELD TEST? FOR A 2ND OPINION FAX THE TESTS TO 817-590-0398 WHEN COMPLETED.

Note any charging system connections that look overheated or discolored:



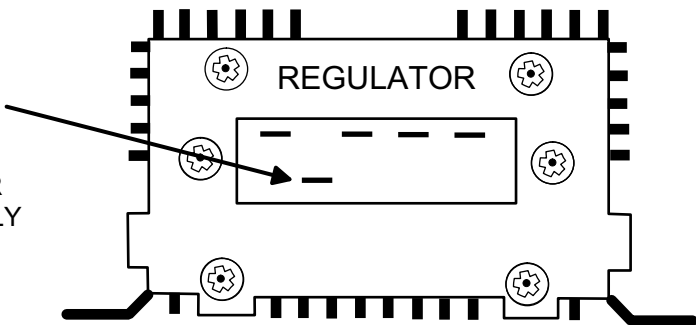
INDUSTRIES, INC.

PX-4000, PX-5000 & PX-6000 REGULATOR

FULL-FIELD TEST

A PX-7000 REGULATOR USES A DIFFERENT TEST

THIS IS A GROUND TERMINAL. DO NOT CONNECT POWER TO THIS TERMINAL OR THE REGULATOR WILL BE PERMANENTLY DAMAGED.



THESE REGULATORS ARE MANUFACTURED IN OUR FT. WORTH, TX PLANT.

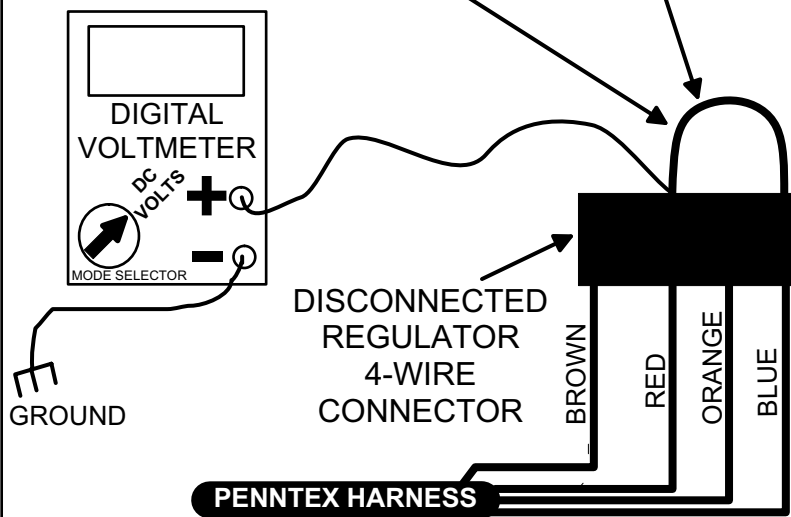
YOU MAY SEE A SPARK WHEN CONNECTING THE JUMPER

JUMPER WIRE

FULL-FIELD TEST PROCEDURE:

- 1) TURN OFF ALL ACCESSORIES
- 2) LOCATE THE VOLTAGE REGULATOR
- 3) **DISCONNECT THE 4-WIRE CONNECTOR**
- 4) JUMP BLUE AND RED WIRES
- 5) START VEHICLE; RUN AT IDLE
- 6) AFTER IT RUNS FOR 15 SECONDS, CHECK VOLTAGE AT RED WIRE
- 7) THAT VOLTAGE IS: _____
- 8) RAISE ENGINE RPM TO 1000 RPM
- 9) CHECK VOLTAGE AT RED WIRE
- 9) THAT VOLTAGE IS NOW: _____
- 10) SHUT ENGINE OFF
- 11) REMOVE JUMPER WIRE

NOTE: DO NOT LET ENGINE RUN MORE THAN 30 SECONDS IN FULL-FIELD MODE. DAMAGE TO THE VEHICLE ELECTRICAL SYSTEM COULD RESULT.



(WHEN WAS THE LAST TIME YOU REPLACED YOUR VOLTMETER BATTERIES?)

A FULL-FIELD TEST DETERMINES IF AN ALTERNATOR WILL CHARGE WITH THE REGULATOR BYPASSED. AFTER COMPLETING THIS TEST AND THE FOUR-STEP VOLTAGE TEST, FAX THEM TO OUR TECHNICAL DEPARTMENT AT 817-590-0398.

07-08-11

PENNTEx INDUSTRIES, INC. TECH LINE: 877-590-7366

FAX: 817-590-0398

tech@penntexusa.com

