

PENNTEX FOUR-STEP CHARGING SYSTEM TEST AND GENERAL INFORMATION
FOR ANY PENNTEX SYSTEM EXCEPT 2009-UP FORDS WITH A PX-7000 VOLTAGE REGULATOR

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 12-volt model Charging Systems with a PX-1000, PX-2000, PX-3000, PX-4000, PX-5000 or PX-6000 Voltage Regulator. To test a PennTex PX-7000 system, contact us or refer to our web site at www.penntexusa.com/tests.

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. *NOTE: recently one bus manufacturer started mounting the regulator behind the passenger side headlamp on GM vans.* 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. (84" away on some Arboc buses.) There should be a white or tan pass-through conduit on the charging system harness at the firewall.

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. On 2007 and older vehicles with a ground wire that went from the regulator to the alternator. It is recommended that the BLACK regulator ground wire at the regulator be shortened to 18 inches with a ring terminal. Attach it 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 the alternator pulley for blue discoloration that indicates a slipping belt. 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 your voltage readings, you can fax the test results to the PennTex technical Department at 817-590-0398 or email to tech@penntexusa.com.

During the **First Step**, 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 Step** with the key on and the engine not running, there should be some voltage (more than .75 volts) on the BROWN wire to energize the regulator. 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 regulator won't be energized and the system will not charge.

With the exception of a PX-6000 system, 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. *GM vehicles with a PX-6000 Regulator should have 3.3 volts on the BLUE wire on Test Two. This is the 30% duty-cycle voltage that the PCM is looking for.* 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 Step**, 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 Step** 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. The engine may benefit from a throttle body cleaning to help this.

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 with the regulator bypassed. (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 doesn't go up, you have an alternator problem. If the voltage does go up, you have may have a regulator problem or it could be a bad rotor. Contact PennTex for the Rotor Test).

NOTE: Electrical system demand that equals the alternator output at idle is really not unusual. 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.

NOTE: If you had zero volts or close to that on the Blue Field wire and the Orange Stator wire on tests 1 through 4, but the alternator starts charging when full-fielded, there might be an issue with the rotor. Check the rotor tests on our web site or contact PennTex for the test information.

SPECIAL NOTE: Until October of 2005, all PX-5 PennTex alternators had one large positive and one large negative connection post. PX-5 alternators built after October 2005, BOTH POSTS ARE POSITIVE. 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 bridge 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 contact the PennTex Technical Department.

Manufacturing/ Tech/ Warranty:

7620 Flagstone Drive

Fort Worth, TX 76118

Ph: 817-590-2818

Toll Free: 877-590-7366

Fax: 817-590-0505, Tech Fax: 817-590-0398

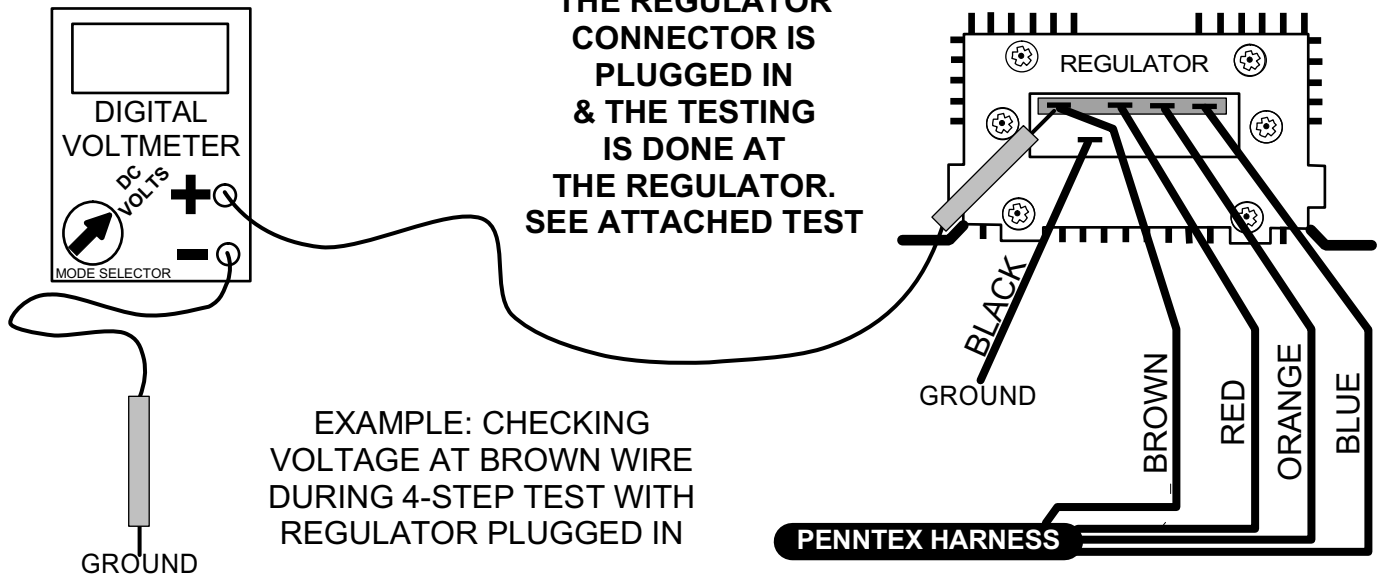
www.penntexusa.com

Email: sales@penntexusa.com

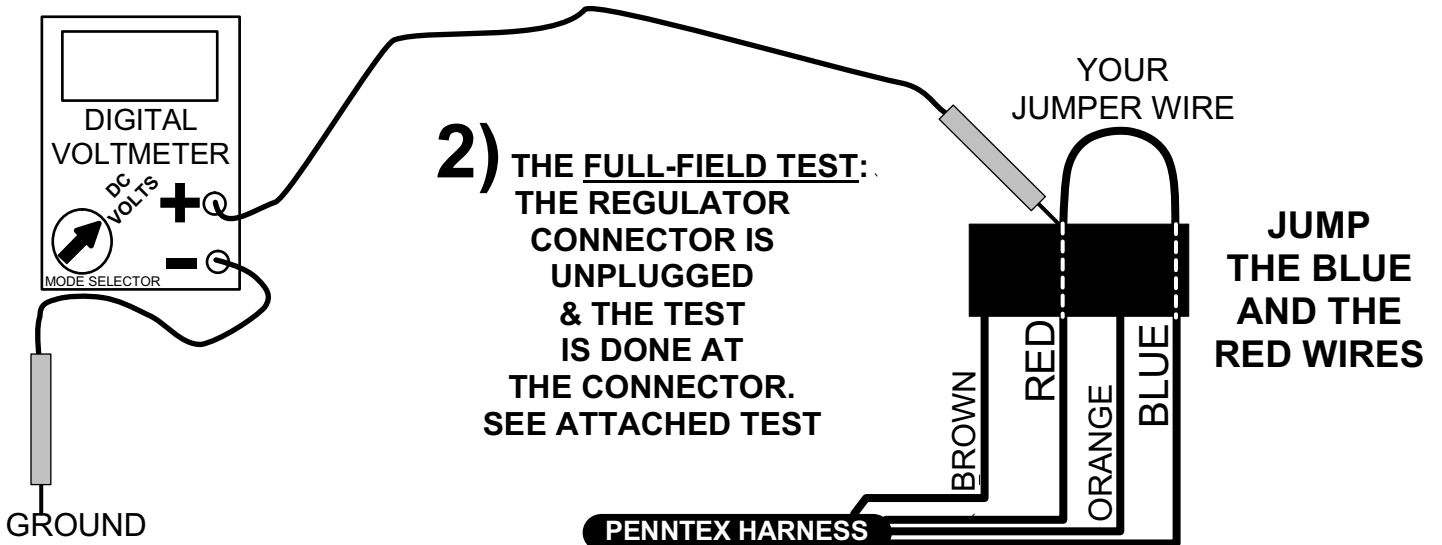
tech@penntexusa.com

INTRODUCTION: THERE ARE TWO TESTS -BOTH NEED TO BE DONE FOR BEST DIAGNOSIS

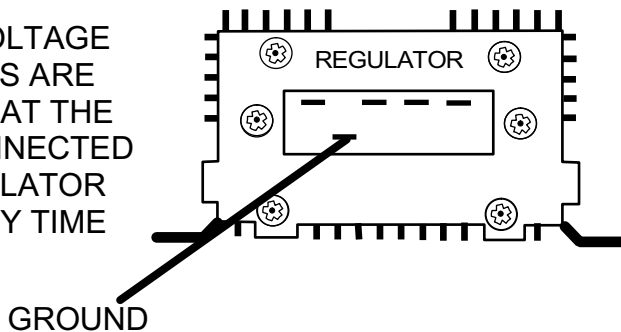
1) THE 4-STEP TEST:
THE REGULATOR CONNECTOR IS PLUGGED IN & THE TESTING IS DONE AT THE REGULATOR. SEE ATTACHED TEST



2) THE FULL-FIELD TEST:
THE REGULATOR CONNECTOR IS UNPLUGGED & THE TEST IS DONE AT THE CONNECTOR. SEE ATTACHED TEST



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
 www.penntexusa.com

Your Company Name _____

Testers Name _____

Phone _____ Ext. _____

Fax _____

Alternator Model # _____

Alternator Serial # _____

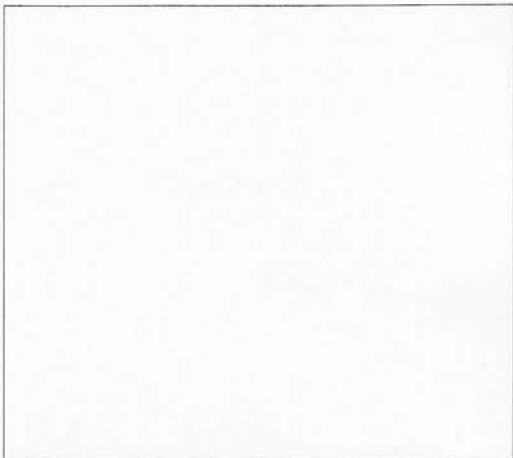
Regulator Model # _____

Regulator Serial # _____

Vehicle Mileage _____

Vehicle Year _____ Make _____ Engine _____

Vehicle OEM Warranty In-Service Date: _____



IF YOUR REGULATOR HAS DIFFERENT CONNECTIONS THAN THIS, SEE THE PX-7000 REGULATOR TESTS



The regulator is usually located inside the vehicle under the right side of the dash or behind the unused passenger-side airbag panel. Some ARBOC GM vans have it behind the passenger-side headlight.

Locate the external voltage regulator. Make sure that everything is properly connected and that the regulator has a good ground. Starting with Test # 1 using a digital voltmeter, check the voltage at each terminal and write the voltage in the box. Do the same with tests 2, 3 & 4.

DO THE 4-STEP TEST WITH EVERYTHING PLUGGED IN

<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)	_____ volts	_____ volts	_____ volts	_____ volts
Battery Terminal	_____ volts	_____ volts	_____ volts	_____ volts

How many batteries does the vehicle have ?

What type of batteries are they ?

Engine Idle Speed :
 _____ RPM

Engine High Idle Speed:
 _____ RPM

Disconnect the BLACK Ground Wire at the Regulator. Using an Ohmmeter, check the Ohms reading on the Black Ground wire connected to the body. The closer to Zero it is, the better the connection you have. The reading was _____ ohms. Reconnect the Black Ground connection to the Voltage Regulator.

PennTex

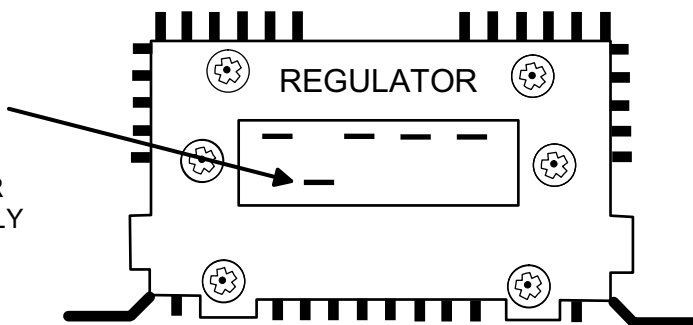
INDUSTRIES, INC.

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

FULL-FIELD TEST

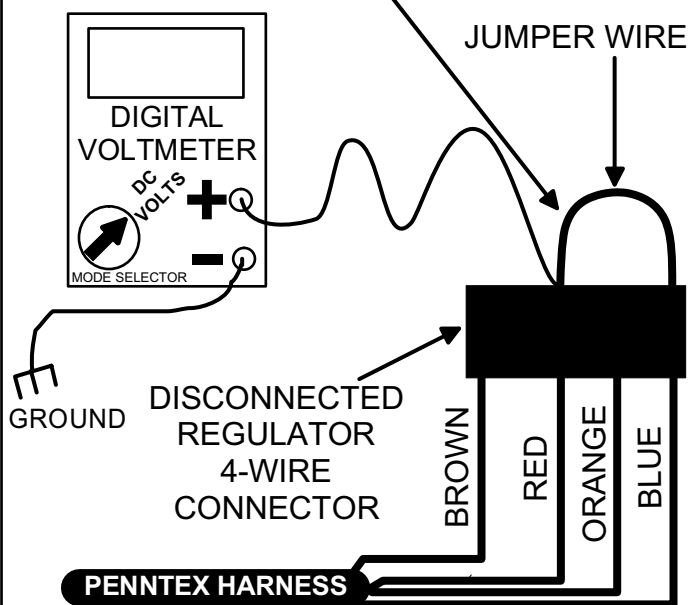
A PX-7000 REGULATOR USES A DIFFERENT TEST

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



FULL-FIELD TEST PROCEDURE:

THIS TEST ALLOWS THE ALTERNATOR TO CHARGE UNREGULATED. IF THE ALTERNATOR IS BAD, THE VOLTAGE WILL NOT INCREASE.

- 1) TURN OFF ALL ACCESSORIES.
 - 2) LOCATE THE VOLTAGE REGULATOR.
 - 3) **DISCONNECT THE 4-WIRE CONNECTOR.**
 - 4) JUMP THE BLUE AND RED WIRES.
 - 5) START THE VEHICLE & RUN AT IDLE.
 - 6) AFTER IT RUNS FOR 5 SECONDS, CHECK THE VOLTAGE AT THE 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. IT COULD BE HOT.
- NOTE:** DO NOT LET ENGINE RUN MORE THAN 10 OR 15 SECONDS IN FULL-FIELD MODE. DAMAGE TO TEST LEADS OR VEHICLE ELECTRICAL SYSTEM CAN RESULT.

(OLD VOLTMETER BATTERIES WILL AFFECT VOLTAGE READINGS ON SOME METERS)

AFTER COMPLETING THIS TEST AND THE FOUR-STEP VOLTAGE TEST, FAX THEM TO OUR TECHNICAL DEPARTMENT AT 817-590-0398.

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

TECH FAX: 817-590-0398
(ALTERNATE FAX: 817-590-0505)
email: tech@penntexusa.com