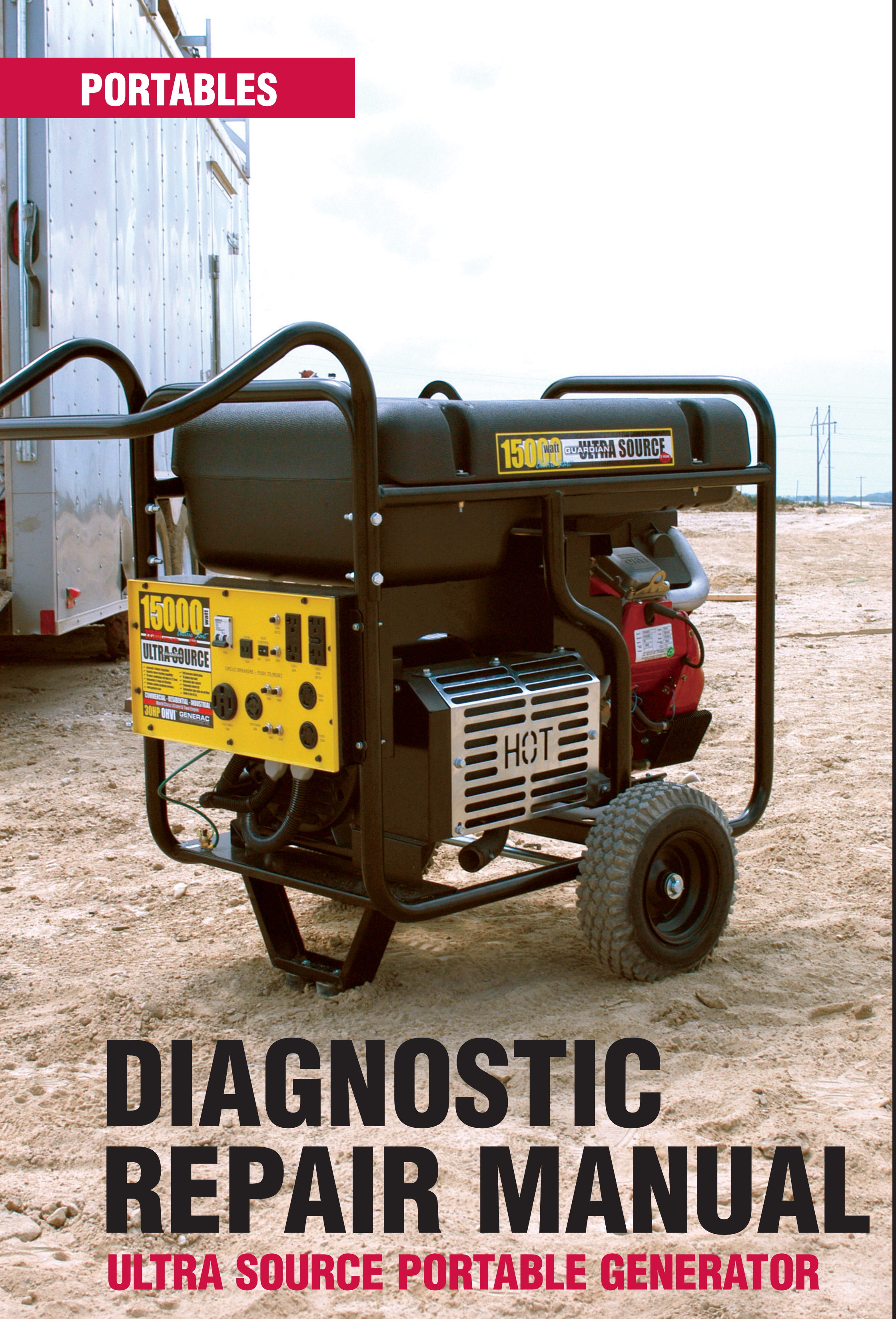
PORTABLES



GUARDIAN®
by Generac Power Systems, Inc.

MODELS:
4451 & 4986 (12,500 Watt)
4582 & 4987 (15,000 Watt)
4583 (17,500 Watt)

GENERAC®
POWER SYSTEMS, INC.

5209 (15,000 Watt)
5308 (17,500 Watt)

# DIAGNOSTIC REPAIR MANUAL

## ULTRA SOURCE PORTABLE GENERATOR

COMMERCIAL
INDUSTRIAL
RESIDENTIAL




www.guardiangenerators.com

## *SAFETY*

Throughout this publication, "DANGER!" and "CAUTION!" blocks are used to alert the mechanic to special instructions concerning a particular service or operation that might be hazardous if performed incorrectly or carelessly. PAY CLOSE ATTENTION TO THEM.

**DANGER! UNDER THIS HEADING WILL BE FOUND SPECIAL INSTRUCTIONS WHICH, IF NOT COMPLIED WITH, COULD RESULT IN PERSONAL INJURY OR DEATH.**

**CAUTION! Under this heading will be found special instructions which, if not complied with, could result in damage to equipment and/or property.**

These "Safety Alerts" alone cannot eliminate the hazards that they signal. Strict compliance with these special instructions plus "common sense" are major accident prevention measures.

## *NOTICE TO USERS OF THIS MANUAL*

This SERVICE MANUAL has been written and published by Generac to aid our dealers' mechanics and company service personnel when servicing the products described herein.

It is assumed that these personnel are familiar with the servicing procedures for these products, or like or similar products manufactured and marketed by Generac. That they have been trained in the recommended servicing procedures for these products, including the use of common hand tools and any special Generac tools or tools from other suppliers.

Generac could not possibly know of and advise the service trade of all conceivable procedures by which a service might be performed and of the possible hazards and/or results of each method. We have not undertaken any such wide evaluation. Therefore, anyone who uses a procedure or tool not recommended by Generac must first satisfy themselves that neither his nor the products safety will be endangered by the service procedure selected.

All information, illustrations and specifications in this manual are based on the latest product information available at the time of publication.

When working on these products, remember that the electrical system and engine ignition system are capable of violent and damaging short circuits or severe electrical shocks. If you intend to perform work where electrical terminals could be grounded or touched, the battery cables should be disconnected at the battery.

Any time the intake or exhaust openings of the engine are exposed during service, they should be covered to prevent accidental entry of foreign material. Entry of such materials will result in extensive damage when the engine Is started.

During any maintenance procedure, replacement fasteners must have the same measurements and strength as the fasteners that were removed. Metric bolts and nuts have numbers that indicate their strength. Customary bolts use radial lines to indicate strength while most customary nuts do not have strength markings. Mismatched or incorrect fasteners can cause damage, malfunction and possible injury.

## *REPLACEMENT PARTS*

Components on Generac recreational vehicle generators are designed and manufactured to comply with Recreational Vehicle Industry Association (RVIA) Rules and Regulations to minimize the risk of fire or explosion. The use of replacement parts that are not in compliance with such Rules and Regulations could result in a fire or explosion hazard. When servicing this equipment, it is extremely important that all components be properly installed and tightened. If improperly installed and tightened, sparks could ignite fuel vapors from fuel system leaks.

## Table of Contents

## *MAGNETISM*

Magnetism can be used to produce electricity and electricity can be used to produce magnetism.

Much about magnetism cannot be explained by our present knowledge. However, there are certain patterns of behavior that are known. Application of these behavior patterns has led to the development of generators, motors and numerous other devices that utilize magnetism to produce and use electrical energy.

See Figure 1-1. The space surrounding a magnet is permeated by magnetic lines of force called “flux”. These lines of force are concentrated at the magnet's north and south poles. They are directed away from the magnet at its north pole, travel in a loop and re-enter the magnet at its south pole. The lines of force form definite patterns which vary in intensity depending on the strength of the magnet. The lines of force never cross one another. The area surrounding a magnet in which its lines of force are effective is called a “magnetic field”.

Like poles of a magnet repel each other, while unlike poles attract each other.

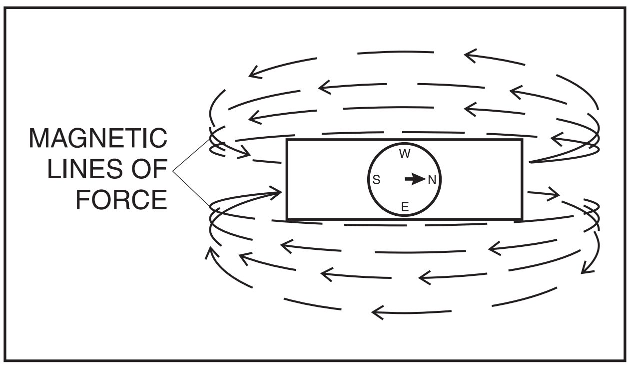



*Figure 1-1. – Magnetic Lines of Force*

## *ELECTROMAGNETIC FIELDS*

All conductors through which an electric current Is flowing have a magnetic field surrounding them. This field is always at right angles to the conductor. If a compass is placed near the conductor, the compass needle will move to a right angle with the conductor. The following rules apply:

- The greater the current flow through the conductor, the stronger the magnetic field around the conductor.
- The increase in the number of lines of force is directly proportional to the increase in current flow and the field is distributed along the full length of the conductor.
- The direction of the lines of force around a conductor can be determined by what is called the “right hand rule”. To apply this rule, place your right hand around the conductor with the thumb pointing in the direction of current flow. The fingers will then be pointing in the direction of the lines of force.

***NOTE: The “right hand rule” is based on the “current flow” theory which assumes that current flows from positive to negative. This is opposite the “electron” theory, which states that current flows from negative to positive.***

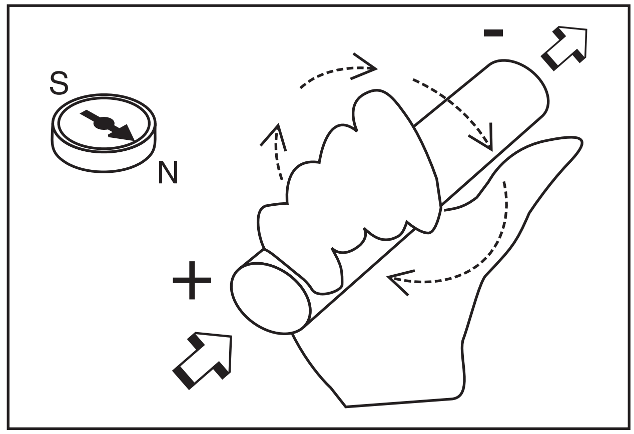



*Figure 1-2. – The Right Hand Rule*

## *ELECTROMAGNETIC INDUCTION*

An electromotive force (EMF) or voltage can be produced in a conductor by moving the conductor so that it cuts across the lines of force of a magnetic field.

Similarly, if the magnetic lines of force are moved so that they cut across a conductor, an EMF (voltage) will be produced in the conductor. This is the basic principal of the revolving field generator.

Figure 1-3, below, illustrates a simple revolving field generator. The permanent magnet (Rotor) is rotated so that its lines of magnetic force cut across a coil of wires called a Stator. A voltage is then induced into the Stator windings. If the Stator circuit is completed by connecting a load (such as a light bulb), current will flow in the circuit and the bulb will light.

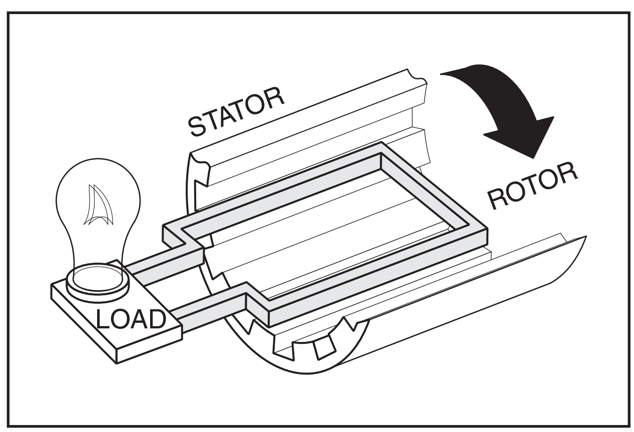



*Figure 1-3. – A Simple Revolving Field Generator*

## A SIMPLE AC GENERATOR

Figure 1-4 shows a very simple AC Generator. The generator consists of a rotating magnetic field called a ROTOR and a stationary coil of wire called a STATOR. The ROTOR is a permanent magnet which consists of a SOUTH magnetic pole and a NORTH magnetic pole.

As the MOTOR turns, its magnetic field cuts across the stationary STATOR. A voltage is induced Into the STATOR windings. When the magnet's NORTH pole passes the STATOR, current flows in one direction. Current flows in the opposite direction when the magnet's SOUTH pole passes the STATOR. This constant reversal of current flow results in an alternating current (AC) waveform that can be diagrammed as shown in Figure 1-5.

The ROTOR may be a 2-pole type having a single NORTH and a single SOUTH magnetic pole. Some ROTORS are 4-pole type with two SOUTH and two NORTH magnetic poles. The following apply:

1. The 2-pole ROTOR must be turned at 3600 rpm to produce an AC frequency of 60 Hertz, or at 3000 rpm to deliver an AC frequency of 50 Hertz.
2. The 4-pole ROTOR must operate at 1800 rpm to deliver a 60 Hertz AC frequency or at 1500 rpm to deliver a 50 Hertz AC frequency.

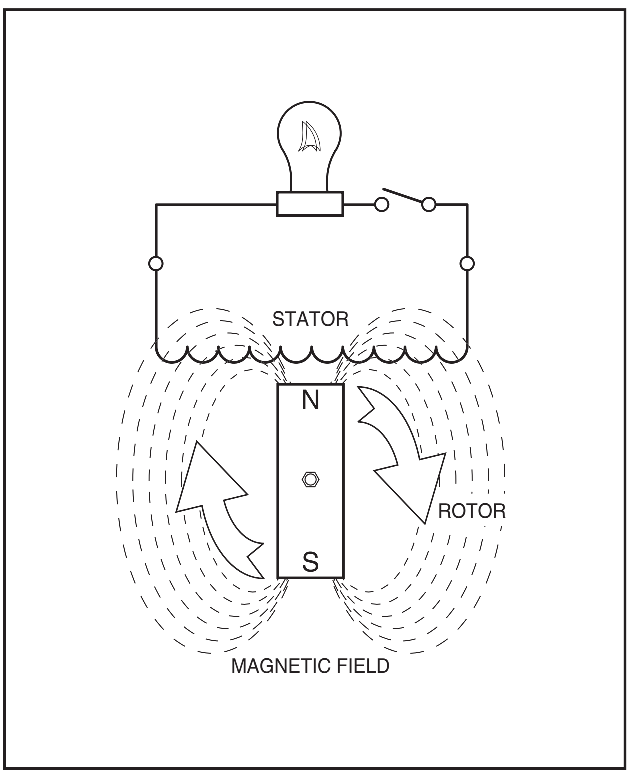



*Figure 1-4. – A Simple AC Generator*

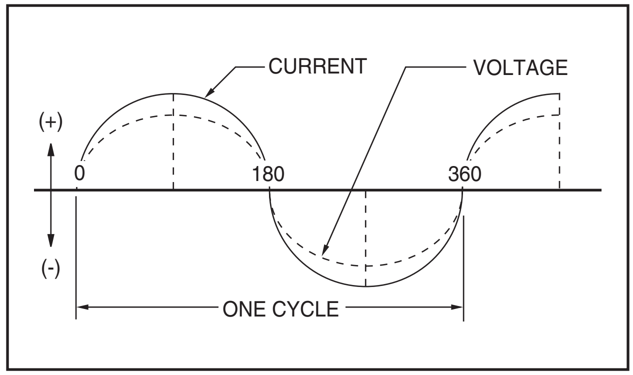



*Figure 1-5. – Alternating Current Sine Wave*

## A MORE SOPHISTICATED AC GENERATOR

Figure 1-6 represents a more sophisticated generator. A regulated direct current is delivered into the ROTOR windings via carbon BRUSHES AND SLIP RINGS. This results in the creation of a regulated magnetic field around the ROTOR. As a result, a regulated voltage is induced into the STATOR. Regulated current delivered to the ROTOR is called "EXCITATION" current.

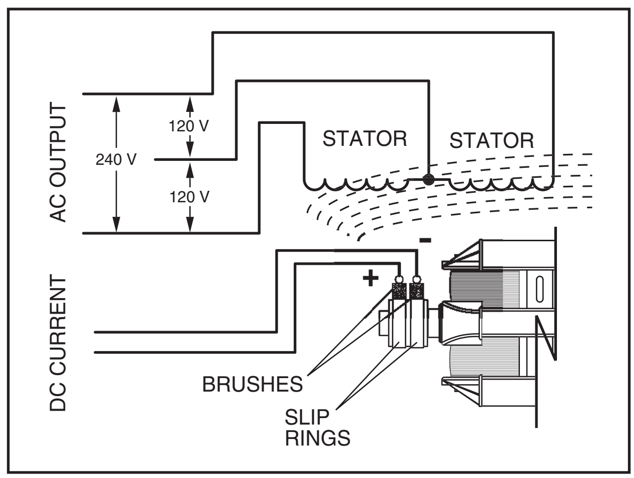



*Figure 1-6. – A More Sophisticated Generator*

See Figure 1-7 (next page). The revolving magnetic field (ROTOR) is driven by the engine at a constant speed. This constant speed is maintained by a mechanical engine governor. Units with a 2-pole rotor require an operating speed of 3600 rpm to deliver a 60 Hertz AC output.

Generator operation may be described briefly as follows:

1. Some "residual" magnetism is normally present in the Rotor and is sufficient to induce approximately 7 to 12 volts AC Into the STATOR's AC power windings.

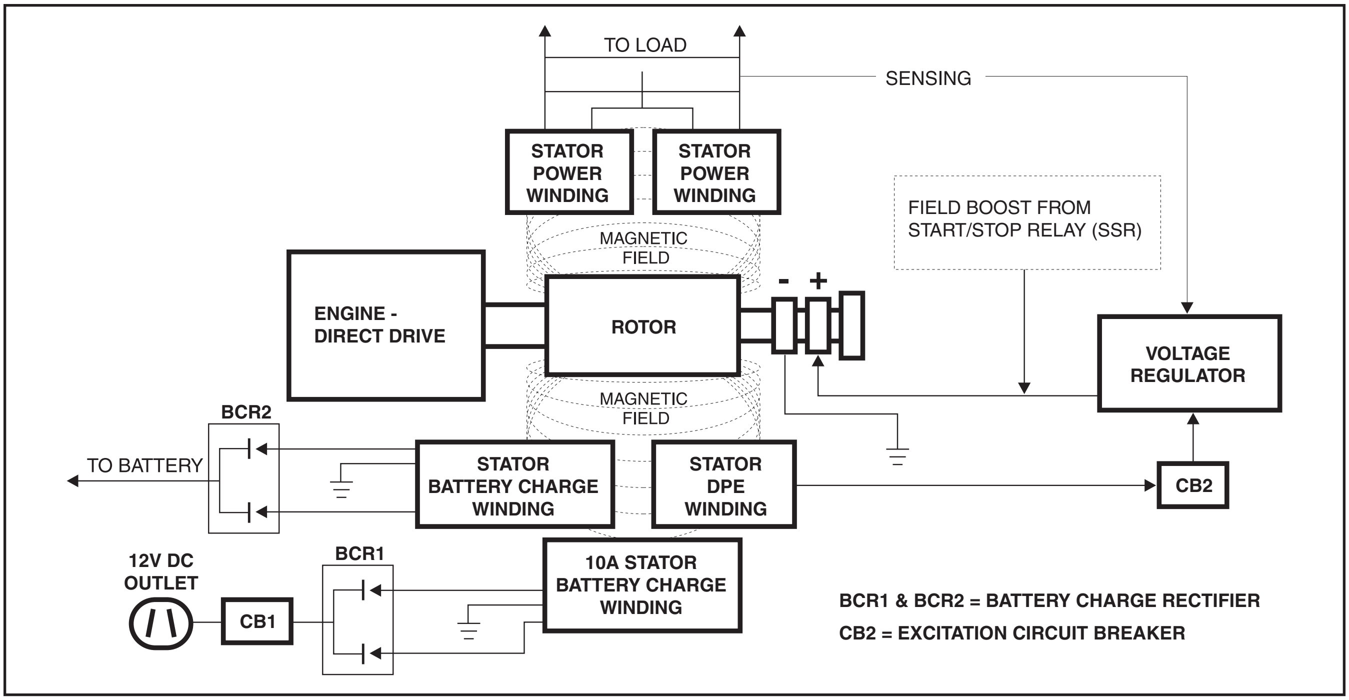



*Figure 1-7. – Generator Operating Diagram*

2. During startup, printed circuit board action controls the START/STOP RELAY to deliver battery voltage to the ROTOR, via the brushes and slip rings.
   a. The battery voltage is called “Field Boost”.
   b. Flow of direct current through the ROTOR increases the strength of the magnetic field above that of “residual” magnetism alone.
3. “Residual” plus “Field Boost” magnetism induces a voltage into the Stator excitation (DPE), battery charge and AC Power windings.
4. Excitation winding unregulated AC output is delivered to an electronic Voltage Regulator, via an Excitation Circuit Breaker.
   a. A “Reference” voltage has been preset into the Voltage Regulator.
   b. An “Actual” (“sensing”) voltage is delivered to the Voltage Regulator via sensing leads from the Stator AC power windings.
   c. The Regulator “compares” the actual (sensing) voltage to its pre-set reference voltage.

      (1) If the actual (sensing) voltage is greater than the pre-set reference voltage, the Regulator will decrease the regulated current flow to the Rotor.

      (2) If the actual (sensing) voltage is less than the pre-set reference voltage, the Regulator will increase the regulated current flow to the Rotor.

      (3) In the manner described, the Regulator maintains an actual (sensing) voltage that is equal to the pre-set reference voltage.

***NOTE: The Voltage Regulator also changes the Stator excitation windings alternating current (AC) output to direct current (DC).***

5. When an electrical load is connected across the Stator power windings, the circuit is completed and an electrical current will flow.
6. The Rotor's magnetic field also induces a voltage into the Stator battery charge windings.
   a. Battery charge winding AC output is delivered to the battery charge rectifiers (BCR) which changes the AC to direct current (DC).
   b. The rectified DC is then delivered to the units battery and battery charge outlet, to maintain the battery in a charged state.

## METERS

Devices used to measure electrical properties are called meters. Meters are available that allow one to measure (a) AC voltage, (b) DC voltage, (c) AC frequency, and (d) resistance in ohms. The following apply:

- To measure AC voltage, use an AC voltmeter.
- To measure DC voltage, use a DC voltmeter.
- Use a frequency meter to measure AC frequency in “Hertz” or “cycles per second”..
- Use an ohmmeter to read circuit resistance, in “ohms”.

## THE VOM

A meter that will permit both voltage and resistance to be read is the “volt-ohm-milliammeter” or “VOM”.

Some VOMs are of the “analog” type (not shown). These meters display the value being measured by physically deflecting a needle across a graduated scale. The scale used must be interpreted by the user.

“Digital” VOM's (Figure 2-1) are also available and are generally very accurate. Digital meters display the measured values directly by converting the values to numbers.

***NOTE: Standard AC voltmeters react to the AVERAGE value of alternating current. When working with AC, the effective value is used. For that reason a different scale is used on an AC voltmeter. The scale is marked with the effective or “rms” value even though the meter actually reacts to the average value. That is why the AC voltmeter will give an incorrect reading if used to measure direct current (DC).***

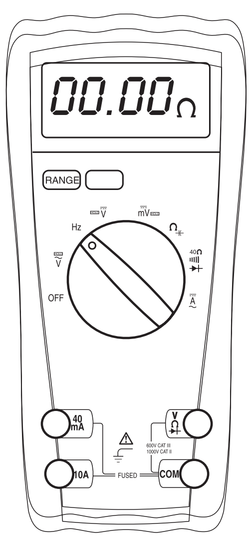



*Figure 2-1. – Digital VOM*

## MEASURING AC VOLTAGE

An accurate AC voltmeter or a VOM may be used to read the generator's AC output voltage. The following apply:

1. Always read the generator's AC output voltage only at the unit's rated operating speed and AC frequency.
2. The generator's Voltage Regulator can be adjusted for correct output voltage only while the unit is operating at its correct rated speed and frequency.
3. Only an AC voltmeter may be used to measure AC voltage. DO NOT USE A DC VOLTMETER FOR THIS PURPOSE.

**DANGER!: GENERATORS PRODUCE HIGH AND DANGEROUS VOLTAGES. CONTACT WITH HIGH VOLTAGE TERMINALS WILL RESULT IN DANGEROUS AND POSSIBLY LETHAL ELECTRICAL SHOCK.**

## MEASURING DC VOLTAGE

A DC voltmeter or a VOM may be used to measure DC voltages. Always observe the following rules:

1. Always observe correct DC polarity.
   a. Some VOM's may be equipped with a polarity switch.
   b. On meters that do not have a polarity switch, DC polarity must be reversed by reversing the test leads.
2. Before reading a DC voltage, always set the meter to a higher voltage scale than the anticipated reading. If in doubt, start at the highest scale and adjust the scale downward until correct readings are obtained.
3. The design of some meters is based on the “current flow” theory while others are based on the “electron flow” theory.
   a. The “current flow” theory assumes that direct current flows from the positive (+) to the negative (-).
   b. The “electron flow” theory assumes that current flows from negative (-) to positive (+).

***NOTE: When testing generators, the “current flow” theory is applied. That is, current is assumed to flow from positive (+) to negative (-).***

## MEASURING AC FREQUENCY

The generator's AC output frequency is proportional to Rotor speed. Generators equipped with a 2-pole Rotor must operate at 3600 rpm to supply a frequency of 60 Hertz. Units with 4-pole Rotor must run at 1800 rpm to deliver 60 Hertz.

Correct engine and Rotor speed is maintained by an engine speed governor. For models rated 60 Hertz, the governor is generally set to maintain a no-load frequency of about 62 Hertz with a corresponding output voltage of about 124 volts AC line-to-neutral. Engine speed and frequency at no-load are set slightly high to prevent excessive rpm and frequency droop under heavy electrical loading.

## MEASURING CURRENT

CLAMP-ON:

To read the current flow, in AMPERES, a clamp-on ammeter may be used. This type of meter indicates current flow through a conductor by measuring the strength of the magnetic field around that conductor. The meter consists essentially of a current transformer with a split core and a rectifier type instrument connected to the secondary. The primary of the current transformer is the conductor through which the current to be measured flows. The split core allows the instrument to be clamped around the conductor without disconnecting it.

Current flowing through a conductor may be measured safely and easily. A line-splitter can be used to measure current in a cord without separating the conductors.

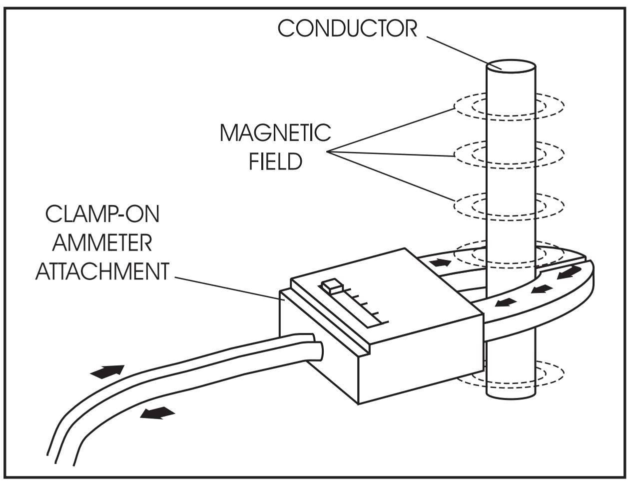



*Figure 2-2. – Clamp-On Ammeter*

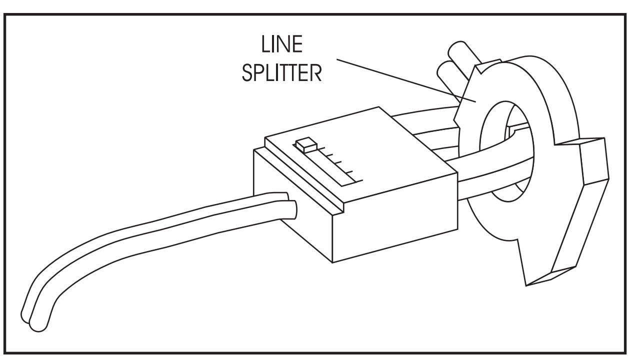



*Figure 2-3. – A Line-Splitter*

***NOTE: If the physical size of the conductor or ammeter capacity does not permit all lines to be measured simultaneously, measure current flow in each individual line. Then, add the individual readings.***

IN-LINE:

Alternatively, to read the current flow in AMPERES, an in-line ammeter may be used. Most Digital Volt Ohm Meters (VOM) will have the capability to measure amperes.

This usually requires the positive meter test lead to be connected to the correct amperes plug, and the meter to be set to the amperes position. Once the meter is properly set up to measure amperes the circuit being measured must be physically broken. The meter will be in-line or in series with the component being measured.

In Figure 2-4 the control wire to a relay has been removed. The meter is used to connect and supply voltage to the relay to energize it and measure the amperes going to it.

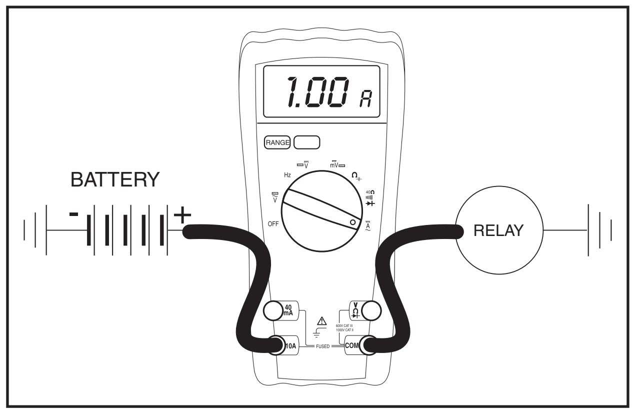



*Figure 2-4. – A VOM as an In-line meter*

## MEASURING RESISTANCE

The volt-ohm-milliammeter may be used to measure the resistance in a circuit. Resistance values can be very valuable when testing coils or windings, such as the Stator and Rotor windings.

When testing Stator windings, keep in mind that the resistance of these windings is very low. Some meters are not capable of reading such a low resistance and will simply read CONTINUITY.

If proper procedures are used, the following conditions can be detected using a VOM:

- A “short-to-ground” condition in any Stator or Rotor winding.
- Shorting together of any two parallel Stator windings.
- Shorting together of any two isolated Stator windings.
- An open condition in any Stator or Rotor winding.

Component testing may require a specific resistance value or a test for INFINITY or CONTINUITY. Infinity is an OPEN condition between two electrical points, which would read as no resistance on a VOM. Continuity is a CLOSED condition between two electrical points, which would be indicated as very low resistance or “ZERO” on a VOM.

## *ELECTRICAL UNITS*

AMPERE:

The rate of electron flow in a circuit is represented by the AMPERE. The ampere is the number of electrons flowing past a given point at a given time. One AMPERE is equal to just slightly more than six thousand million billion electrons per second ($6.25 \times 10^{18}$).

With alternating current (AC), the electrons flow first in one direction, then reverse and move in the opposite direction. They will repeat this cycle at regular intervals. A wave diagram, called a “sine wave” shows that current goes from zero to maximum positive value, then reverses and goes from zero to maximum negative value. Two reversals of current flow is called a cycle. The number of cycles per second is called frequency and is usually stated in “Hertz”.

VOLT:

The VOLT is the unit used to measure electrical PRESSURE, or the difference in electrical potential that causes electrons to flow. Very few electrons will flow when voltage is weak. More electrons will flow as voltage becomes stronger. VOLTAGE may be considered to be a state of unbalance and current flow as an attempt to regain balance. One volt is the amount of EMF that will cause a current of 1 ampere to flow through 1 ohm of resistance.

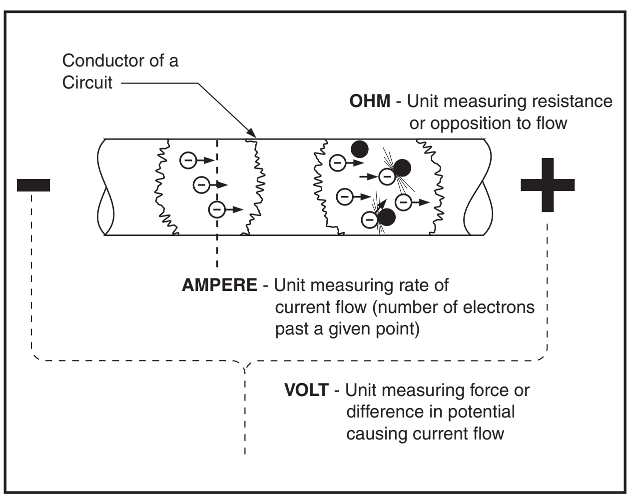



*Figure 2-5. – Electrical Units*

OHM:

The OHM is the unit of RESISTANCE. In every circuit there is a natural resistance or opposition to the flow of electrons. When an EMF is applied to a complete circuit, the electrons are forced to flow in a single direction rather than their free or orbiting pattern. The resistance of a conductor depends on (a) its physical makeup, (b) its cross-sectional area, (c) its length, and (d) its temperature. As the conductor's temperature increases, its resistance increases in direct proportion. One (1) ohm of resistance will permit one (1) ampere of current to flow when one (1) volt of electromotive force (EMF) is applied.

## *OHM'S LAW*

A definite and exact relationship exists between VOLTS, OHMS and AMPERES. The value of one can be calculated when the value of the other two are known. Ohm's Law states that in any circuit the current will increase when voltage increases but resistance remains the same, and current will decrease when resistance Increases and voltage remains the same.

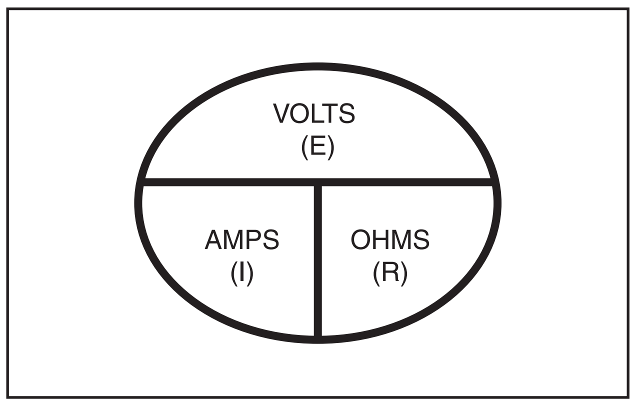



*Figure 2-6. – Ohm's Law*

If AMPERES is unknown while VOLTS and OHMS are known, use the following formula:

$$\textbf{AMPERES} = \frac{\textbf{VOLTS}}{\textbf{OHMS}}$$

If VOLTS is unknown while AMPERES and OHMS are known, use the following formula:

***VOLTS = AMPERES x OHMS***

If OHMS is unknown but VOLTS and AMPERES are known, use the following:

$$\textbf{OHMS} = \frac{\textbf{VOLTS}}{\textbf{AMPERES}}$$

## *INTRODUCTION*

The generator revolving field (rotor) is driven by an air-cooled engine at about 3600 rpm.

The generator may be used to supply electrical power for the operation of 120 and/or 240 volts, 1-phase, 60 Hz, AC loads.

## *ENGINE-GENERATOR DRIVE SYSTEM*

The generator revolving field is driven by an air-cooled, horizontal crankshaft engine. The generator is directly coupled to the engine crankshaft (see Figure 1). Both the engine and generator rotor are driven at approximately 3600 rpm, to provide a 60 Hz AC output.

## *THE AC GENERATOR*

Figure 3-1 shows the major components of the AC generator.

## *ROTOR ASSEMBLY*

The 2-pole rotor must be operated at 3600 rpm to supply a 60 Hertz AC frequency. The term “2-pole” means the rotor has a single north magnetic pole and a single south magnetic pole. As the rotor rotates, its lines of magnetic flux cut across the stator assembly windings and a voltage is induced into the stator windings. The rotor shaft mounts a positive (+) and a negative (-) slip ring, with the positive (+) slip ring nearest the rear bearing carrier (Figure 3-2). The rotor bearing is pressed onto the end of the rotor shaft. The tapered rotor shaft is mounted to a tapered crankshaft and is held in place with a single through bolt.

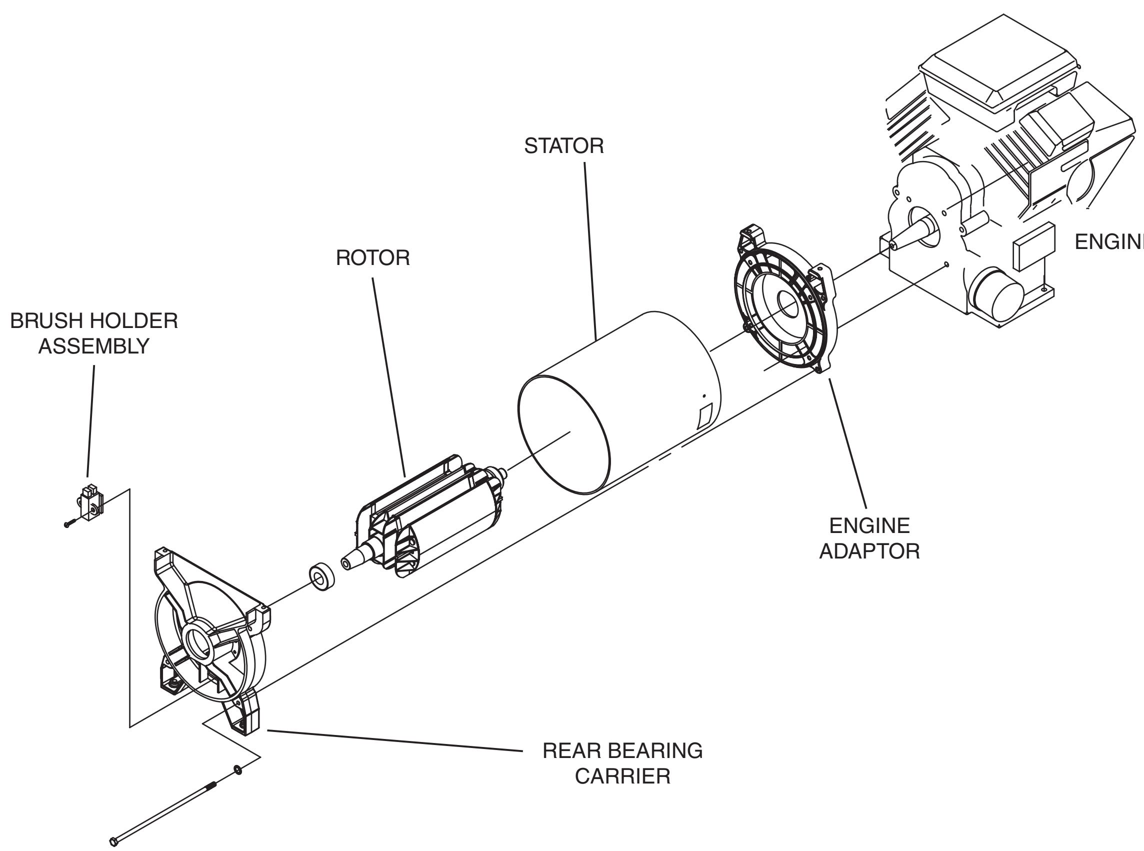



*Figure 3-1. – AC Generator Exploded View*

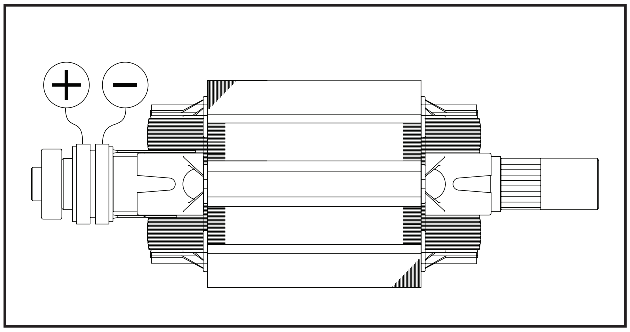



*Figure 3-2. – The 2-Pole Rotor Assembly*

### STATOR ASSEMBLY

The stator can houses and retains (a) dual AC power windings, (b) an excitation winding, and (c) two battery charge windings. A total of thirteen (13) stator leads are brought out of the stator can as shown in Figure 3-3.

The stator can is sandwiched between an engine adapter and a rear bearing carrier. It is retained in that position by four stator studs.

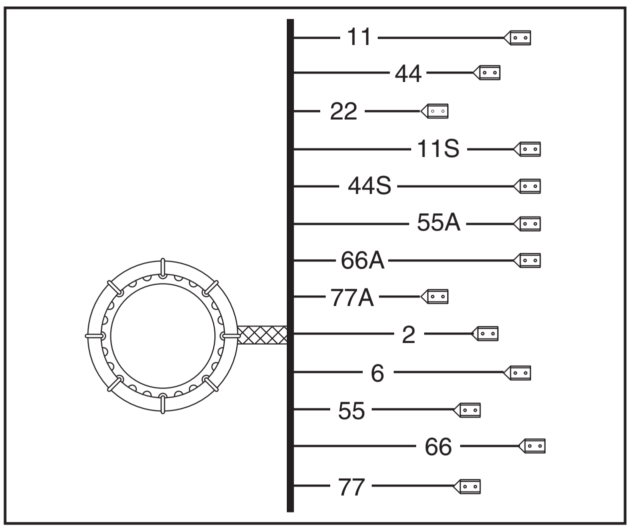



*Figure 3-3. – Stator Assembly Leads*

### BRUSH HOLDER AND BRUSHES

The brush holder is retained to the rear bearing carrier by means of two Taptite screws. A positive (+) and a negative (-) brush are retained in the brush holder, with the positive (+) brush riding on the slip ring nearest the rotor bearing.

Wire 4 connects to the positive (+) brush and Wire 0 to the negative (-) brush. Wire 0 connects to frame ground. Rectified and regulated excitation current, as well as current from a field boost circuit, are delivered to the rotor windings via Wire 4, and the positive (+) brush and slip ring. The excitation and field boost current passes through the windings and to frame ground via the negative (-) slip ring and brush, and Wire 0. This current flow creates a magnetic field around the rotor having a flux concentration that is proportional to the amount of current flow.

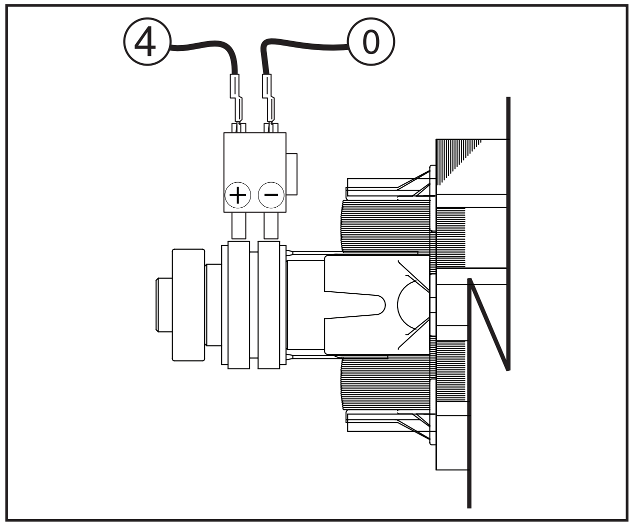



*Figure 3-4. – Brush Holder and Brushes*

### OTHER AC GENERATOR COMPONENTS

Some AC generator components are housed in the generator control panel enclosure. These are (a) an Excitation Circuit Breaker, (b) a Voltage Regulator, and (c) a main line circuit breaker.

<u>EXCITATION CIRCUIT BREAKER:</u>

The Excitation Circuit Breaker (CB2) is housed in the generator control panel enclosure and electrically connected in series with the excitation (DPE) winding output to the Voltage Regulator. The breaker is self-resetting, i.e.; its contacts will close again when excitation current drops to a safe value.

If the circuit breaker has failed open, excitation current flow to the Voltage Regulator and, subsequently, to the rotor windings will be lost. Without excitation current flow, AC voltage induced into the stator AC power windings will drop to a value that is commensurate with the rotor residual magnetism (see Figure 3-5).

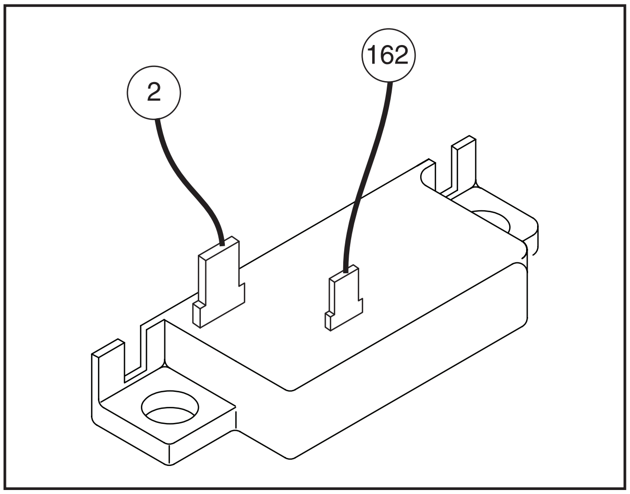



*Figure 3-5. – Excitation Circuit Breaker*

VOLTAGE REGULATOR:

A typical Voltage Regulator is shown in Figure 3-6 (12.5 & 15 kW Units) or Figure 3-7 (17.5 kW Units). Unregulated AC output from the stator excitation winding is delivered to the regulator's DPE terminals, via Wire 2, the Excitation Circuit Breaker and Wire 162, and Wire 6. The Voltage Regulator rectifies that current and, based on stator AC power winding sensing, regulates it. The rectified and regulated excitation current is then delivered to the rotor windings from the positive (+) and negative (-) regulator terminals, via Wire 4 and Wire 0. Stator AC power winding "sensing" is delivered to the regulator "SEN" terminals via Wires 11S and 44S.

The regulator provides "over-voltage" protection, but does not protect against "under-voltage". On occurrence of an "over-voltage" condition, the regulator will "shut down" and complete loss of excitation current to the rotor will occur. Without excitation current, the generator AC output voltage will drop to approximately one-half (or lower) of the unit's rated voltage.

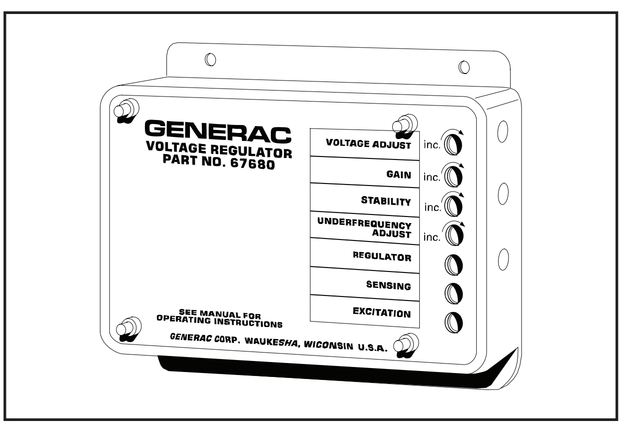



*Figure 3-6. – Typical Voltage Regulator Found on 12.5 kW and 15 kW Units*

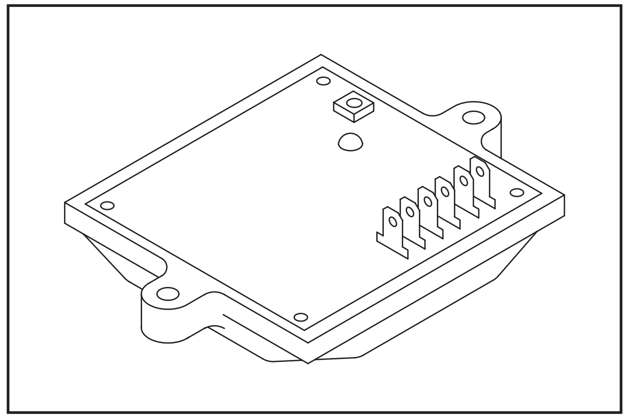


*Figure 3-7. – Typical Voltage Regulator Found on 17.5 Units*

ADJUSTMENT PROCEDURE (12.5 AND 15 KW UNITS):

The Voltage Regulator is equipped with three light emitting diodes (LED's). These LED's are normally on during operation with no faults in the system The RED regulator LED is on when the regulator is on and functioning. The Yellow sensing LED is powered by sensing input to the regulator from the stator AC power windings. The GREEN excitation LED is powered by stator excitation winding output.

Four adjustment potentiometers are provided. They are VOLTAGE ADJUST, GAIN, STABILITY, and UNDERFREQUENCY ADJUST.

1. Connect an AC Voltage/Frequency meter across wires 11 & 44 at the 50A Main circuit breaker. Verify frequency is between 59-61Hz.
2. On the regulator, set the adjustment pots as follows.
   a. Voltage Adjust – Pot-turn fully counterclockwise
   b. Gain – turn to midpoint (12 O'clock)
   c. Stability – turn to midpoint (12 O'clock)
   d. Under Frequency – turn to midpoint (12 O'clock)
3. Start the generator. This adjustment will be done under a no-load condition.
4. Turn the regulator's Voltage Adjust pot clockwise to obtain a line to line voltage of 238-242 VAC.
5. If the red regulator LED is flashing, slowly turn the stability pot either direction until flashing stops.

ADJUSTMENT PROCEDURE (17.5 KW UNITS):

A single red lamp (LED) glows during normal operation. The lamp will become dim if excitation winding AC output diminishes. It will go out on occurrence of an open condition in the sensing AC output circuit.

An adjustment potentiometer permits the stator AC power winding voltage to be adjusted. Perform this adjustment with the generator running at no-load, and with a 62 Hz AC frequency (62 Hz equals 3720 rpm). At the stated no-load frequency, adjust to obtain a line-to-line AC voltage of about 252 volts.

CIRCUIT BREAKERS:

Each individual outlet on the generator is protected by a circuit breaker to prevent overload.

## *ROTOR RESIDUAL MAGNETISM*

The generator revolving field (rotor) may be considered to be a permanent magnet. Some "residual" magnetism is always present in the rotor. This residual magnetism is sufficient to induce a voltage into the stator AC power windings that is approximately 2-12 volts AC.

## *FIELD BOOST CIRCUIT*

When the engine is cranked during start-up, the START/STOP RELAY (SSR) will be energized. The normally open contacts of the SSR will close and Wire 15 will supply 12 VDC to Wire 14. Connected to Wire 14 is a resistor (R1) and a diode (D1). The resistor will limit current flow, and the diode will block Voltage Regulator DC output. Once through the resistor and diode it becomes Wire 4, and Wire 4 then connects to the positive brush. The effect is to "flash the field" every time the engine is cranked. Field boost current helps ensure that sufficient "pickup" voltage is available on every startup to turn the Voltage Regulator on and build AC output voltage.

Notice that field boost current is always available during cranking and running, this is because the SSR is energized the whole time. The diode (D1) prevents or blocks the Voltage Regulators higher DC output from reaching the Wire 14 run circuit.

Field boost voltage is reduced from that of battery voltage by the resistor (R1), and when read with a DC voltmeter will be approximately 9 or 10 volts DC.

## *OPERATION*

STARTUP:

When the engine is started, residual plus field boost magnetism from the rotor induces a voltage into (a) the stator AC power windings, (b) the stator excitation or DPE windings, (c) the stator battery charge windings. In an "on-speed" (engine cranking) condition, residual plus field boost magnetism are capable of creating approximately one-half the unit's rated voltage.

ON-SPEED OPERATION:

As the engine accelerates, the voltage that is induced into the stator windings increases rapidly, due to the increasing speed at which the rotor operates.

FIELD EXCITATION:

An AC voltage is induced into the stator excitation (DPE) windings. The DPE winding circuit is completed to the Voltage Regulator, via Wire 2, Excitation Circuit Breaker, Wire 162, and Wire 6. Unregulated alternating current can flow from the winding to the regulator.

The Voltage Regulator "senses" AC power winding output voltage and frequency via stator Wires 11S and 44S.

The regulator changes the AC from the excitation winding to DC. In addition, based on the Wires 11S and 44S sensing signals, it regulates the flow of direct current to the rotor.

The rectified and regulated current flow from the regulator is delivered to the rotor windings, via Wire 4, and the positive brush and slip ring. This excitation current flows through the rotor windings and is directed to ground through the negative (-) slip ring and brush, and Wire 0.

The greater the current flow through the rotor windings, the more concentrated the lines of flux around the rotor become.

The more concentrated the lines of flux around the rotor that cut across the stationary stator windings, the greater the voltage that is induced into the stator windings.

Initially, the AC power winding voltage sensed by the regulator is low. The regulator reacts by increasing the flow of excitation current to the rotor until voltage increases to a desired level. The regulator then maintains the desired voltage. For example, if voltage exceeds the desired level, the regulator will decrease the flow of excitation current. Conversely, if voltage drops below the desired level, the regulator responds by increasing the flow of excitation current.

AC POWER WINDING OUTPUT:

A regulated voltage is induced into the stator AC power windings. When electrical loads are connected across the AC power windings to complete the circuit, current can flow in the circuit. The regulated AC power winding output voltage will be in direct proportion to the AC frequency. For example, on units rated 120/240 volts at 60 Hz, the regulator will try to maintain 240 volts (line-to-line) at 60 Hz. This type of regulation system provides greatly improved motor starting capability over other types of systems.

BATTERY CHARGE WINDING OUTPUT:

A voltage is induced into the battery charge winding. Output from these windings is delivered to a Battery Charge Rectifier (BCR2), via Wires 55A, 66A and 77A. The resulting direct current from the BCR is delivered to the unit battery, via Wire 15, a 10 amp fuse, and Wire 13. This output is used to maintain battery state of charge during operation.

10 AMP BATTERY CHARGE WINDING OUTPUT:

A voltage is induced into the battery charge winding. Output from these windings is delivered to a Battery Charge Rectifier (BCR1), via Wires 55, 66 and 77.

The resulting direct current from the BCR is delivered to the 12 VDC receptacle, via Wire 13A, CB1, and Wire 15A. This receptacle allows the capability to recharge a 12 volt DC storage battery with provided battery charge cables.

## *INSULATION RESISTANCE*

The insulation resistance of stator and rotor windings is a measurement of the integrity of the insulating materials that separate the electrical windings from the generator steel core. This resistance can degrade over time or due to such contaminants as dust, dirt, oil, grease and especially moisture. In most cases, failures of stator and rotor windings is due to a breakdown in the insulation. In many cases, a low insulation resistance is caused by moisture that collects while the generator is shut down. When problems are caused by moisture buildup on the windings, they can usually be corrected by drying the windings. Cleaning and drying the windings can usually eliminate dirt and moisture built up in the generator windings.

## *THE MEGOHMMETER*

GENERAL:

A megohmmeter, often called a "megger", consists of a meter calibrated in megohms and a power supply. Use a power supply of 500 volts when testing stators or rotors. DO NOT APPLY VOLTAGE LONGER THAN ONE (1) SECOND.

TESTING STATOR INSULATION:

All parts that might be damaged by the high megger voltages must be disconnected before testing. Isolate all stator leads (Figure 3-9) and connect all of the stator leads together. FOLLOW THE MEGGER MANUFACTURER'S INSTRUCTIONS CAREFULLY.

Use a megger power setting of 500 volts. Connect one megger test lead to the junction of all stator leads, the other test lead to frame ground on the stator can. Read the number of megohms on the meter.

The MINIMUM acceptable megger reading for stators may be calculated using the following formula:

$$\text{MINIMUM INSULATION RESISTANCE (in "Megohms")} = \frac{\text{GENERATOR RATED VOLTS}}{1000} + 1$$

***EXAMPLE: Generator is rated at 120 volts AC. Divide "120" by "1000" to obtain "0.12". Then add "1" to obtain "1.12" megohms. Minimum insulation resistance for a 120 VAC stator is 1.12 megohms.***

If the stator insulation resistance is less than the calculated minimum resistance, clean and dry the stator. Then, repeat the test. If resistance is still low, replace the stator.

Use the Megger to test for shorts between isolated windings as outlined "Stator Insulation Tests".

Also test between parallel windings. See "Test Between Windings" on next page.

TESTING ROTOR INSULATION:

Apply a voltage of 500 volts across the rotor positive (+) slip ring (nearest the rotor bearing), and a clean frame ground (i.e. the rotor shaft). DO NOT EXCEED 500 VOLTS AND DO NOT APPLY VOLTAGE LONGER THAN 1 SECOND. FOLLOW THE MEGGER MANUFACTURER'S INSTRUCTIONS CAREFULLY.

**ROTOR MINIMUM INSULATION RESISTANCE:
1.5 megohms**

⚠ **CAUTION: Before attempting to measure Insulation resistance, first disconnect and Isolate all leads of the winding to be tested. Electronic components, diodes, surge protectors, relays, Voltage Regulators, etc., can be destroyed if subjected to high megger voltages.**

HI-POT TESTER:

A "Hi-Pot" tester is shown in Figure 3-8. The model shown is only one of many that are commercially available. The tester shown is equipped with a voltage selector switch that permits the power supply voltage to be selected. It also mounts a breakdown lamp that will illuminate to indicate an insulation breakdown during the test.

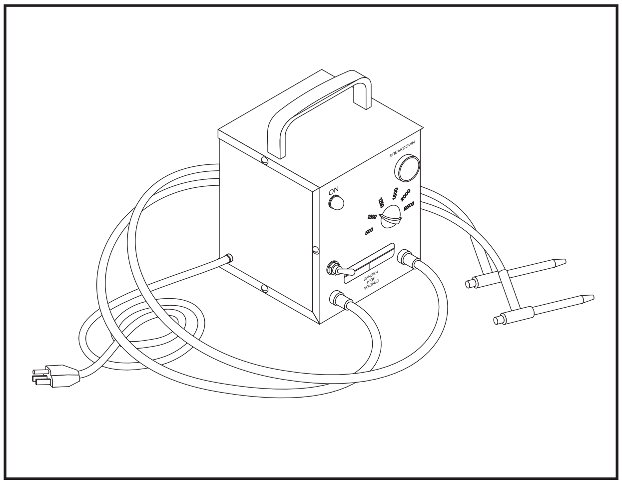


*Figure 3-8. – One Type of Hi-Pot Tester*

## *STATOR INSULATION RESISTANCE TEST*

GENERAL:

Units with air-cooled engines are equipped with (a) center tapped AC power windings, (b) an excitation or DPE winding, (c) a center tapped battery charge winding and (d) a 10 Amp center tapped battery charge winding. Insulation tests of the stator consist of (a) testing all windings to ground, (b) testing between isolated windings, and (c) testing between parallel windings. Figure 3-9 is a pictorial representation of the various stator leads on units with air-cooled engine.

TESTING ALL STATOR WINDINGS TO GROUND:

1. Disconnect stator output leads Wire 11 and Wire 44 from the generator 50A circuit breaker.
2. Remove stator output lead Wire 22 from the neutral terminal on the back of the 50A outlet.
3. Disconnect the C1 connector from the bottom of the control panel. See Figure 3-10. The C1 connector is on the right when facing the control panel.

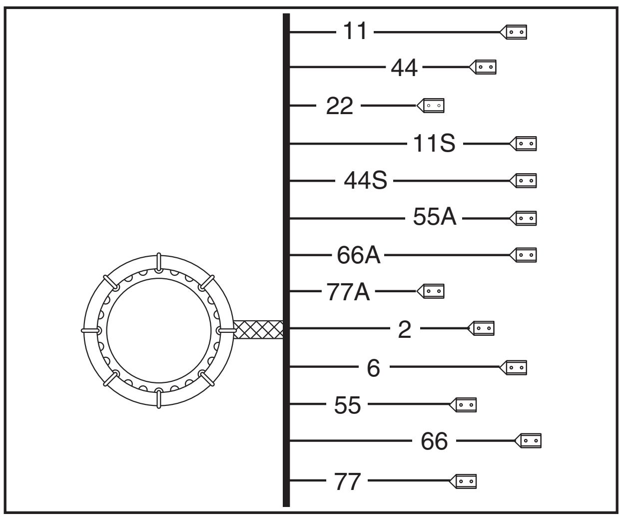



*Figure 3-9. – Stator Winding Leads*

4. Connect the terminal ends of Wires 11, 22, and 44 together. Make sure the wire ends are not touching any part of the generator frame or any terminal.
5. Connect the red test probe of the Hi-Pot tester to the joined terminal ends of stator leads 11, 22, and 44. Connect the black tester lead to a clean frame ground on the stator can. With tester leads connected in this manner, proceed as follows:
   a. Turn the Hi-Pot tester switch OFF.
   b. Plug the tester cord into a 120 volt AC wall socket and set its voltage selector switch to "1500 volts".
   c. Turn the tester switch ON and observe the breakdown lamp on tester. DO NOT APPLY VOLTAGE LONGER THAN 1 SECOND. After one (1) second, turn the tester switch OFF.

If the breakdown lamp comes on during the one-second test, the stator should be cleaned and dried. After cleaning and drying, repeat the insulation test. If, after cleaning and drying, the stator fails the second test, the stator assembly should be replaced.

6. Now proceed to the C1 connector ( Female side – Just removed). Each winding will be individually tested for a short to ground. Insert a large paper clip (or similar item) into the C1 connector at the following pin locations:

| Pin Location | Wire Number | Winding |
|---|---|---|
| 1 | 11S | Sense Lead Power |
| 2 | 44S | Sense Lead Power |
| 3 | 55A | Battery Charge |
| 4 | 66A | Battery Charge |
| 5 | 77A | Battery Charge |
| 6 | 2 | Excitation |
| 7 | 6 | Excitation |
| 8 | 55 | 10 Amp Battery Charge |
| 9 | 66 | 10 Amp Battery Charge |
| 10 | 77 | 10 Amp Battery Charge |
| 11 | 4 | (Positive lead to Brush) |
| 12 | 0 | (Negative lead to Brush) |

Next refer to Steps 5a through 5c of the Hi-Pot procedure.

***Example: Insert paper clip into Pin 1, Hi-Pot from Pin 1 (Wire 11S) to ground. Proceed to Pin 2, Pin 3, etc. through Pin 10.***

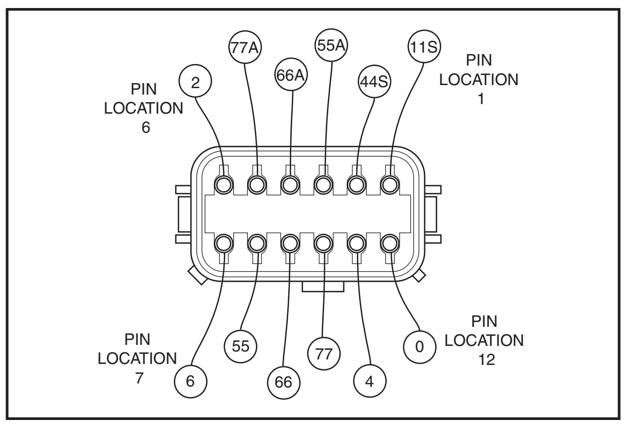



*Figure 3-10. – C1 Connector Pin Location Numbers (Female Side, Located to the Right When Facing the Control Panel)*

TEST BETWEEN WINDINGS:

1. Insert a paper clip into Pin Location 3 (Wire 55A). Connect the red tester probe to the paper clip. Connect the black tester probe to Stator Lead 11. Refer to Steps 5a through 5c of "TESTING ALL STATOR WINDINGS TO GROUND".
2. Repeat Step 1 at Pin Location 6 (Wire 2) and Stator Lead 11.

3. Repeat Step 1 at Pin Location 8 (Wire 55) and Stator Lead 11.

For the following steps (4 through 6) an additional paper clip (or similar item) will be needed:

4. Insert a paper clip into Pin Location 3 (Wire 55A). Connect the red tester probe to the paper clip. Insert additional paper clip into Pin Location 6 (Wire 2). Connect the black tester probe to this paper clip. Refer to Steps 5a through 5c of "TESTING ALL STATOR WINDINGS TO GROUND" on the previous page.
5. Insert a paper clip into Pin Location 3 (Wire 55A). Connect the red tester probe to the paper clip. Insert additional paper clip into Pin Location 8 (Wire 55). Connect the black tester probe to this paper clip. Refer to Steps 5a through 5c of "TESTING ALL STATOR WINDINGS TO GROUND" on the previous page.
6. Insert a paper clip into Pin Location 6 (Wire 2). Connect the red tester probe to the paper clip. Insert the additional paper clip into Pin Location 8 (Wire 55). Connect the black tester probe to this paper clip. Refer to Steps 5a through 5c of "TESTING ALL STATOR WINDINGS TO GROUND" on the previous page.

### *ROTOR INSULATION RESISTANCE TEST*

Before attempting to test rotor insulation, the brush holder must be completely removed. The rotor must be completely isolated from other components before starting the test. Attach all leads of all stator windings to ground.

1. Connect the red tester lead to the positive (+) slip ring (nearest the rotor bearing).
2. Connect the black tester probe to a clean frame ground, such as a clean metal part of the rotor shaft.

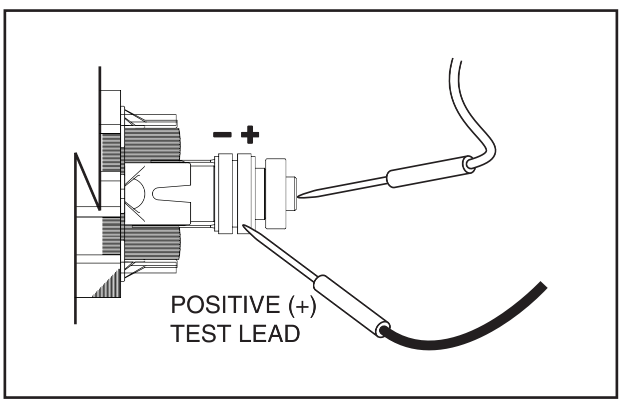



*Figure 3-10. – Testing Rotor Insulation*

3. Turn the tester switch OFF.
4. Plug the tester into a 120 volts AC wall socket and set the voltage switch to "1500 volts".
5. Turn the tester switch "On" and make sure the pilot light has turned on.
6. Observe the breakdown lamp, then turn the tester switch OFF. DO NOT APPLY VOLTAGE LONGER THAN ONE (1) SECOND.

If the breakdown lamp came on during the one (1) second test, cleaning and drying of the rotor may be necessary. After cleaning and drying, repeat the insulation breakdown test. If breakdown lamp comes on during the second test, replace the rotor assembly.

### *CLEANING THE GENERATOR*

Caked or greasy dirt may be loosened with a soft brush or a damp cloth. A vacuum system may be used to clean up loosened dirt. Dust and dirt may also be removed using dry, low-pressure air (25 psi maximum).

⚠ **CAUTION: Do not use sprayed water to clean the generator. Some of the water will be retained on generator windings and terminals, and may cause very serious problems.**

### *DRYING THE GENERATOR*

To dry a generator, proceed as follows:

1. Open the generator main circuit breaker. NO ELECTRICAL LOADS MUST BE APPLIED TO THE GENERATOR WHILE DRYING.
2. Provide an external source to blow warm, dry air through the generator interior (around the rotor and stator windings. DO NOT EXCEED 185° F. (85° C.).
3. Start the generator and let it run for 2 or 3 hours.
4. Shut the generator down and repeat the stator and rotor insulation resistance tests.

## PRINTED CIRCUIT BOARD

GENERAL:

The printed board is responsible for cranking, startup, running and shutdown operations. The board interconnects with other components of the DC control system to turn them on and off at the proper times. It is powered by fused 12 VDC power from the unit battery.

CIRCUIT BOARD CONNECTIONS:

The circuit board mounts a 12-pin receptacle (J2) and a 5-pin receptacle (J1). Figure 4-2 shows the 12-pin receptacle (J2), the associated wires and the function of each pin and wire.

DIP SWITCH POSITIONS:

***Note: These switches must remain in the positions set at the factory.***

1. Stepper Motor Rotation
   a. Switch set to ON for clockwise rotation (Factory Position).
   b. Switch set to OFF for counterclockwise rotation.
2. Frequency Setting
   a. Switch set to OFF for 60 Hertz (Factory Position).
   b. Switch set to ON for 50 Hertz.

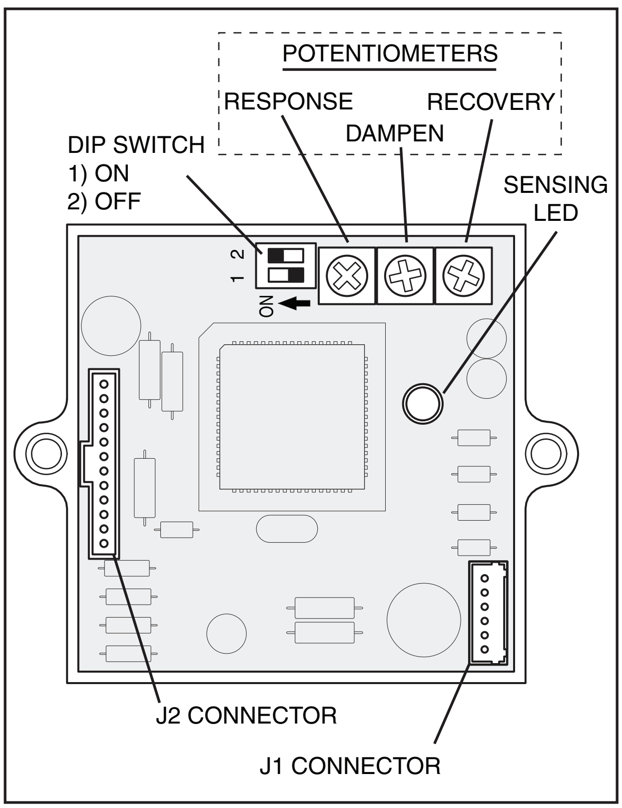



*Figure 4-1. – Printed Circuit Board*

| TERMINAL | WIRE | FUNCTION |
|---|---|---|
| 1 | 15B | 12 VDC input when the Start Stop Relay (SSR) is energized. |
| 2 | 83 | Ground input when the idle control switch (SW2) is placed in the closed position |
| 3 | TR1 | AC voltage input from the idle control transformers. |
| 4 | 0 | Common ground for the PCB |
| 5 | 167 | 12 VDC input when SW1 is placed in the Start position. Ground input when SW1 is placed in the Stop position. |
| 6 | TR2 | AC voltage input from the idle control transformers. |
| 7 | 86 | Fault shutdown circuit. When grounded by closure of the Low Oil pressure switch (LOP) engine will shut down. |
| 8 | 229 | Switched to ground for Start Stop Relay (SSR) operation. |
| 9 | | NOT USED |
| 10 | 44S | AC input for frequency control. 11S/44S 240VAC |
| 11 | | NOT USED |
| 12 | 11S | AC input for frequency control. 11S/44S 240VAC |

***Note: J1 Connector is utilized for governor control.***

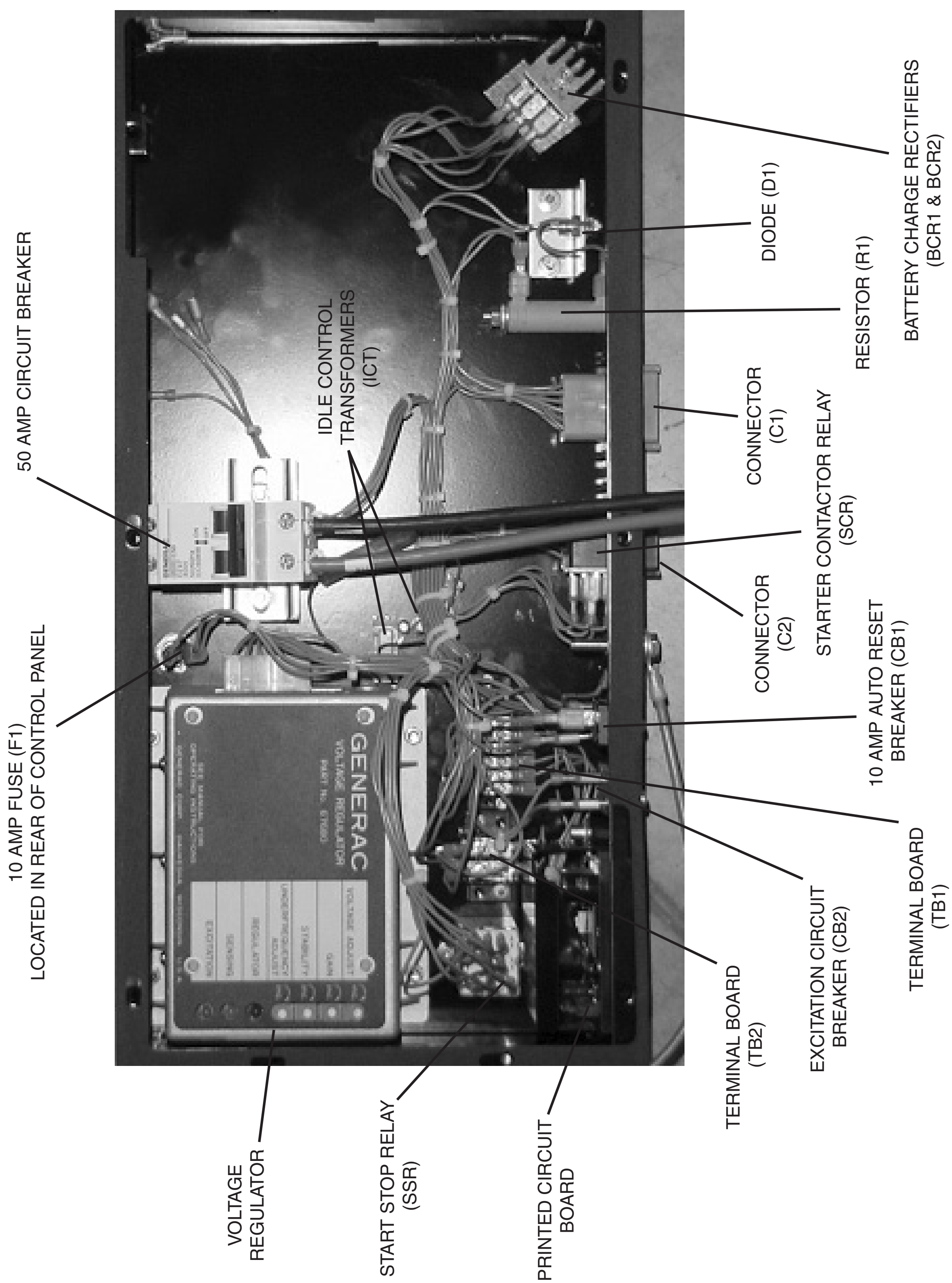
*Figure 4-2. – Receptacle J2*

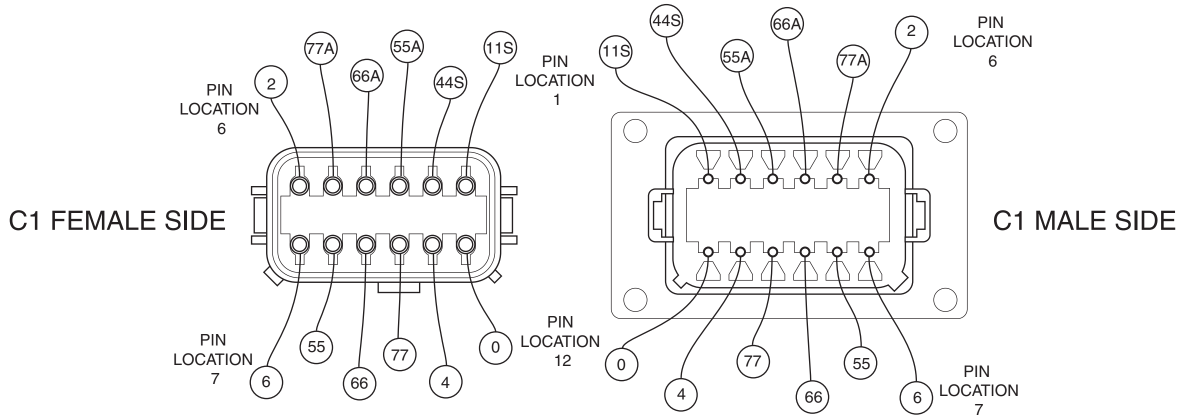
## BATTERY

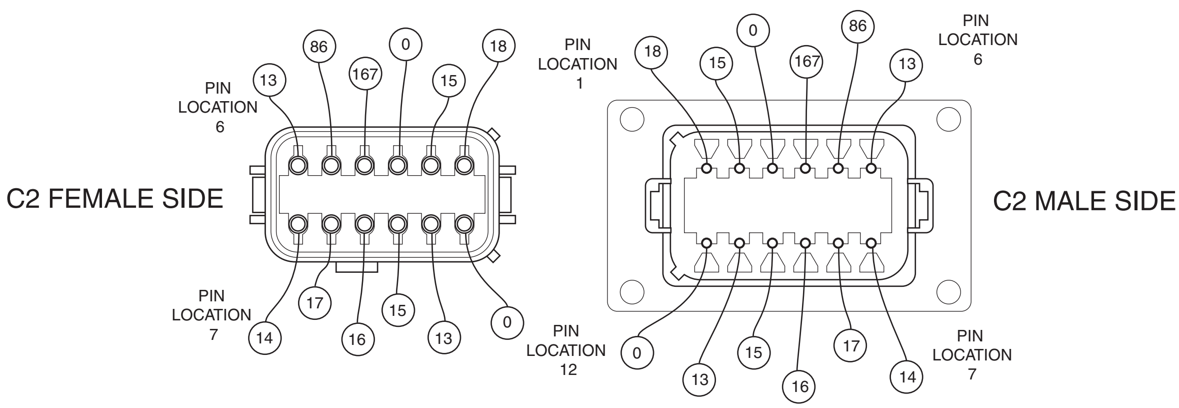
RECOMMENDED BATTERY:

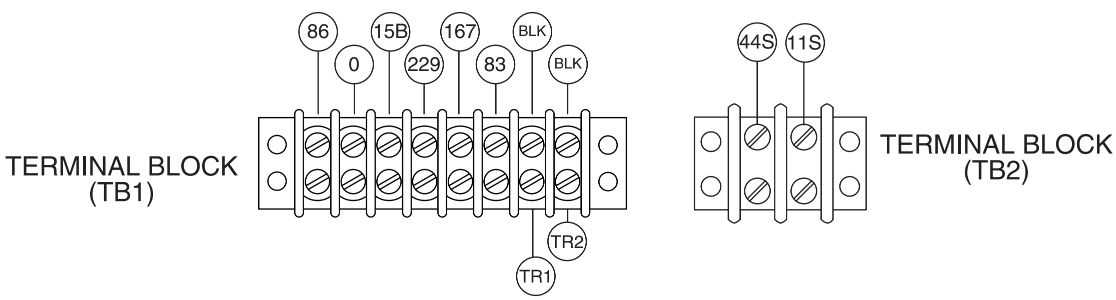
When anticipated ambient temperatures will be consistently above 32° F. (0° C.), use a 12 volts Type U1 storage battery capable of delivering at least 300 cold cranking amperes.

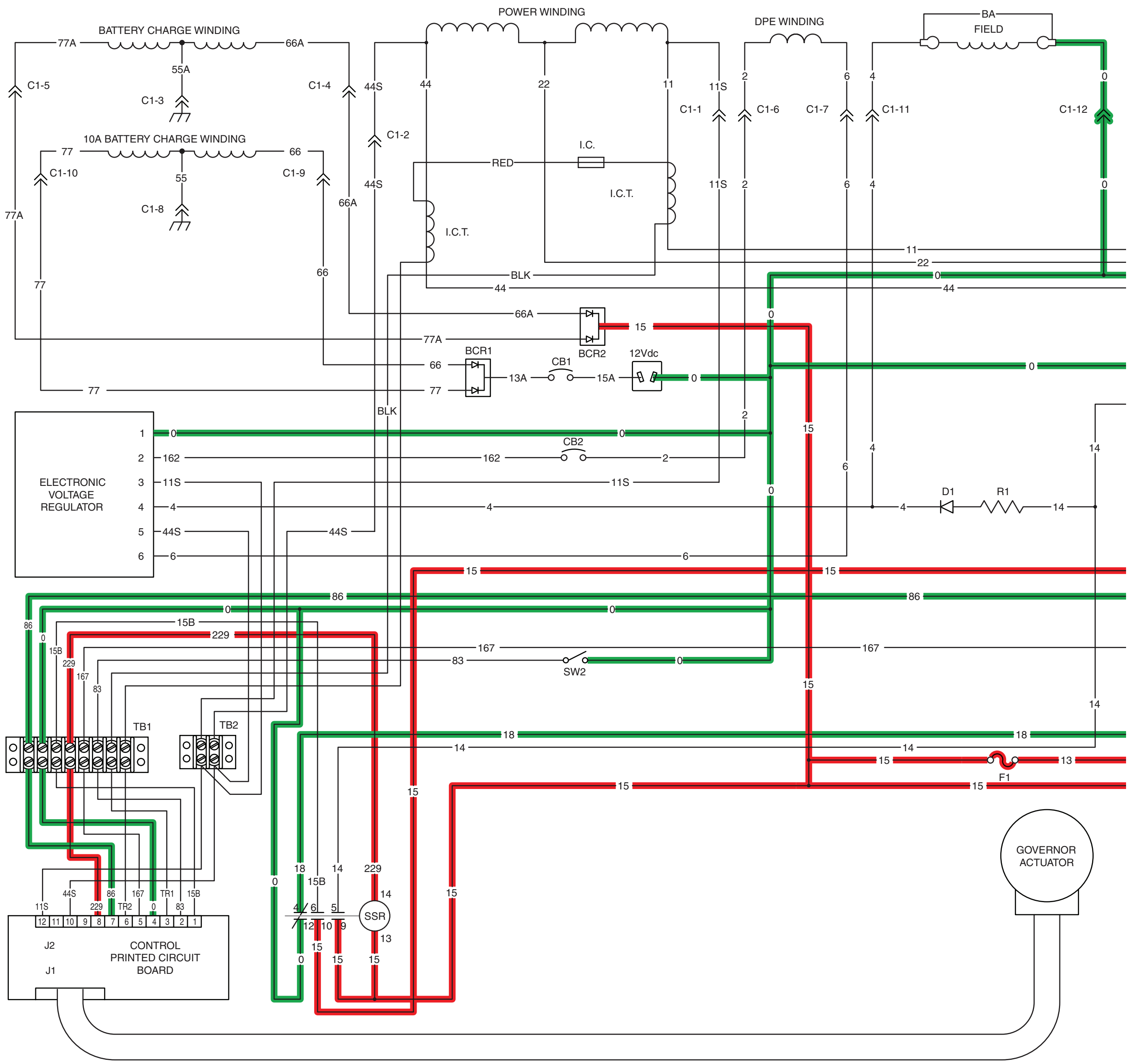
## *CONTROL PANEL COMPONENT IDENTIFICATION*




C1 FEMALE SIDE
PIN LOCATION 6
PIN LOCATION 7
2
77A
66A
55A
44S
11S
6
55
66
77
4
0
PIN LOCATION 1
PIN LOCATION 12
C1 MALE SIDE
11S
44S
55A
66A
77A
2
PIN LOCATION 6
0
4
77
66
55
6
PIN LOCATION 7


C2 FEMALE SIDE
PIN LOCATION 6
PIN LOCATION 7
13
86
167
0
15
18
14
17
16
15
13
0
PIN LOCATION 1
PIN LOCATION 12
C2 MALE SIDE
18
15
0
167
86
13
PIN LOCATION 6
0
13
15
16
17
14
PIN LOCATION 7


86
0
15B
229
167
83
BLK
BLK
TERMINAL BLOCK (TB1)
TR1
TR2
44S
11S
TERMINAL BLOCK (TB2)




## *CIRCUIT CONDITION - REST:*

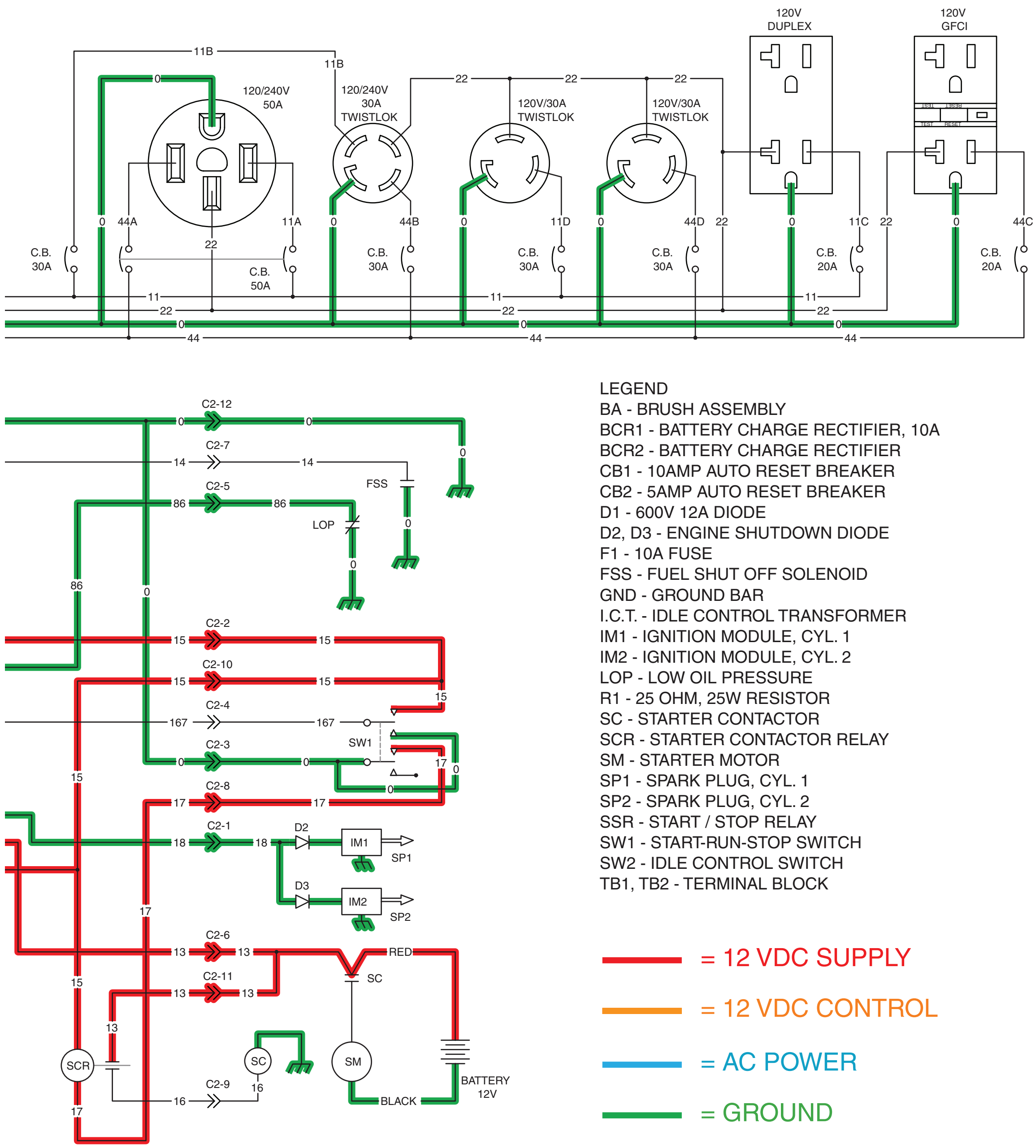
Battery voltage is supplied to components of the control system from the unit BATTERY via the RED battery cable connected to the contacts of the starter contactor (SC), wire 13, a 10 Amp fuse (F1), and Wire 15.

Wire 13 is unfused battery supply voltage and is connected to the contacts of the Starter Contactor Relay (SCR).

Wire 15 12 VDC fused battery supply voltage is supplied to the SCR coil, it goes through the coil and comes out as wire 17 12 VDC, wire 17 is connected to the Start-Run-Stop switch (SW1) and is held open to ground. No current flows through the circuit and the SCR is de-energized.

Wire 15 12 VDC fused battery supply voltage is supplied to SW1 and is held open to Wire 167.

Wire 15 12 VDC fused battery supply voltage is supplied to the Start-Stop Relay (SSR) it goes through the coil and comes out as wire 229 12 VDC, wire 229 is connected to the printed circuit board and is held open to ground. No current flows through the circuit and the SSR is de-energized.




LEGEND
BA - BRUSH ASSEMBLY
BCR1 - BATTERY CHARGE RECTIFIER, 10A
BCR2 - BATTERY CHARGE RECTIFIER
CB1 - 10AMP AUTO RESET BREAKER
CB2 - 5AMP AUTO RESET BREAKER
D1 - 600V 12A DIODE
D2, D3 - ENGINE SHUTDOWN DIODE
F1 - 10A FUSE
FSS - FUEL SHUT OFF SOLENOID
GND - GROUND BAR
I.C.T. - IDLE CONTROL TRANSFORMER
IM1 - IGNITION MODULE, CYL. 1
IM2 - IGNITION MODULE, CYL. 2
LOP - LOW OIL PRESSURE
R1 - 25 OHM, 25W RESISTOR
SC - STARTER CONTACTOR
SCR - STARTER CONTACTOR RELAY
SM - STARTER MOTOR
SP1 - SPARK PLUG, CYL. 1
SP2 - SPARK PLUG, CYL. 2
SSR - START / STOP RELAY
SW1 - START-RUN-STOP SWITCH
SW2 - IDLE CONTROL SWITCH
TB1, TB2 - TERMINAL BLOCK

= 12 VDC SUPPLY

= 12 VDC CONTROL

= AC POWER

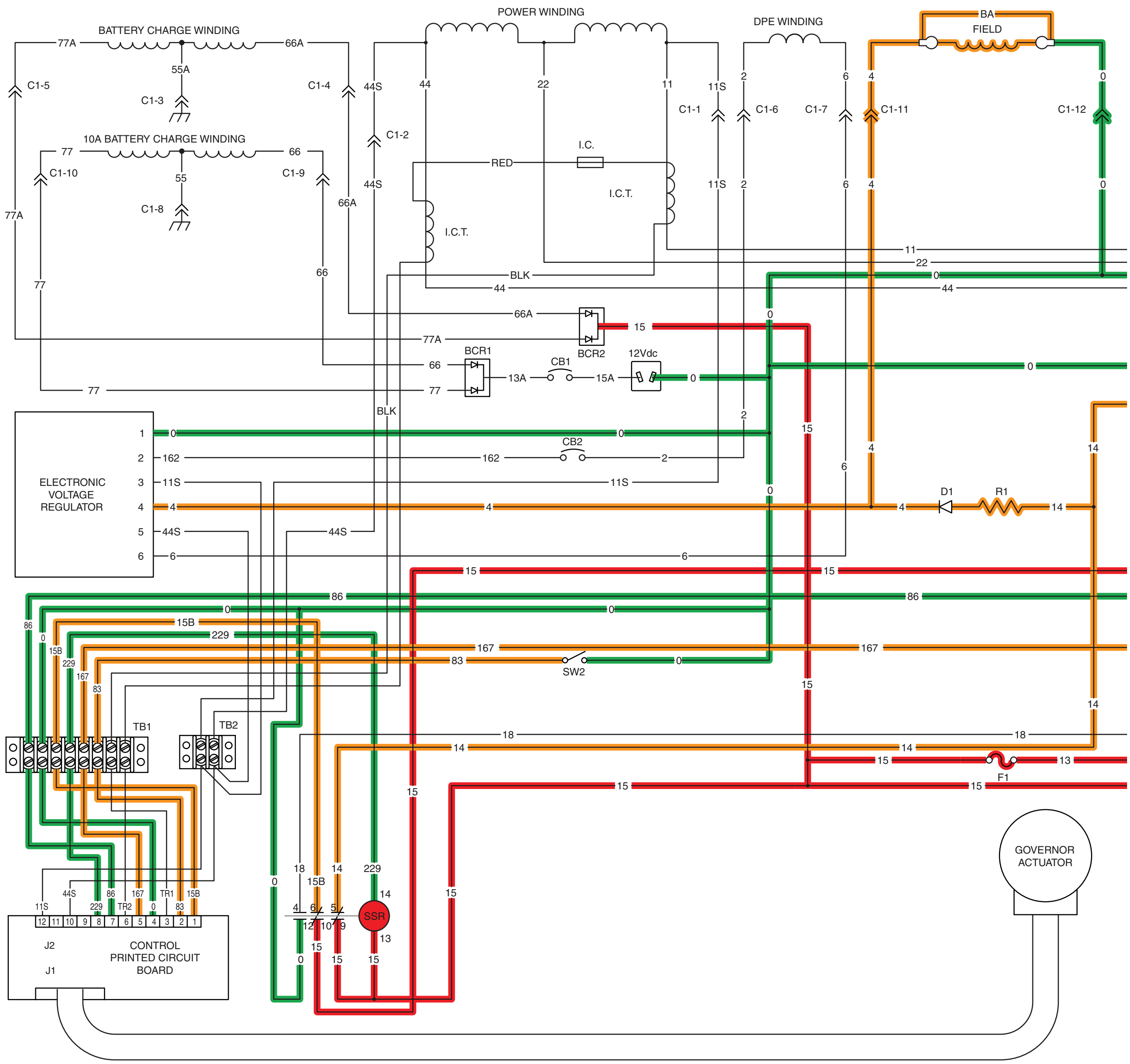
= GROUND

Wire 15 12 VDC fused battery supply voltage is supplied to the normally open contacts of the SSR. One set of normally open contacts are connected to Wire 15B, the other set of normally open contacts are connected to Wire 14. The SSR is de-energized and no voltage is available through the contacts.

Wire 15 12 VDC fused battery supply voltage is supplied to the Battery Charge Rectifier number 2 (BCR2). This is a return current path for battery charging. No current flows at this time.

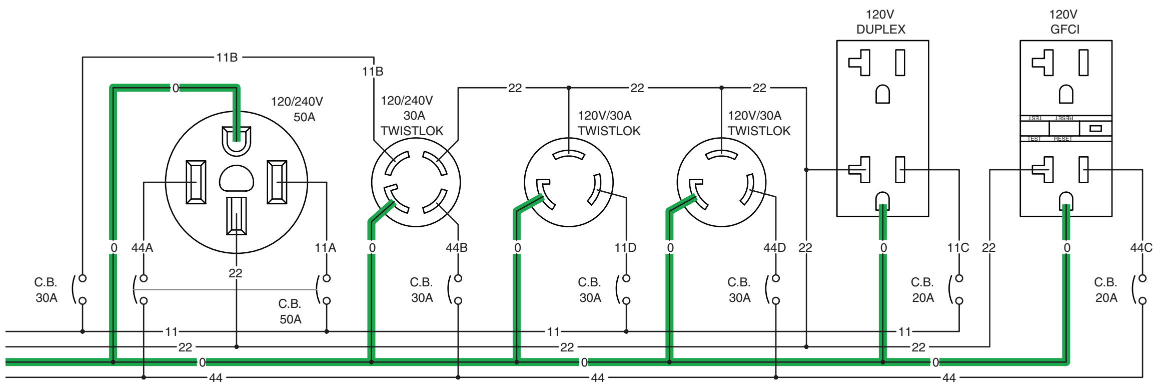
Wire 18 connects to the ignition magnetos and to the normally closed contacts of the SSR. The normally closed contacts are also connected to Wire 0, Wire 0 is frame ground.

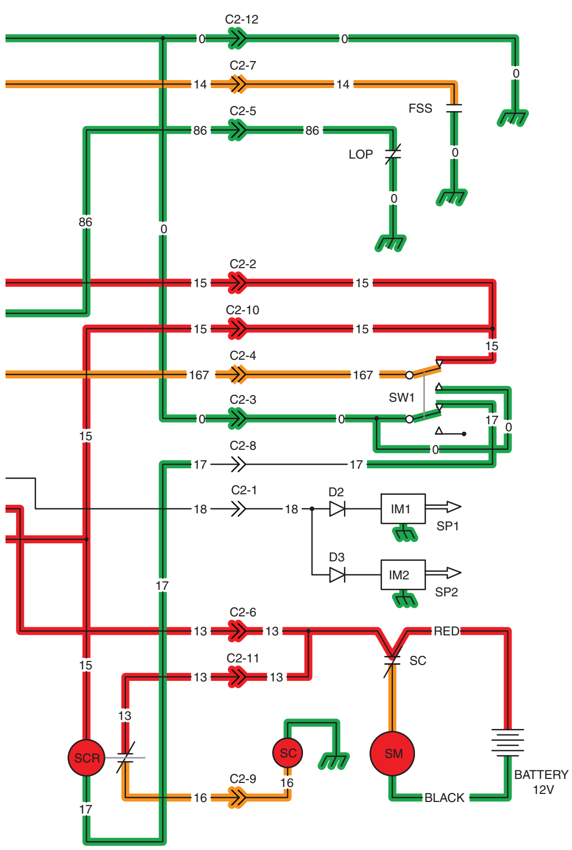
The SSR is de-energized and the magnetos are grounded out at this time, no spark is available.




## *CIRCUIT CONDITION - START:*

With the Start-Run-Stop Switch (SW1) held in the start position, Wire 17 from the Starter Contactor Relay (SCR) is now connected to Wire 0 which is frame ground. This allows current to flow and the SCR is energized. The SCR contacts close connecting Wire 13 battery power to Wire 16. Wire 16 now supplies battery power to the starter contactor (SC) on the Starter Motor (SM), the SC is energized and its contacts close, battery power is available to the Starter Motor (SM) and the engine is cranking.

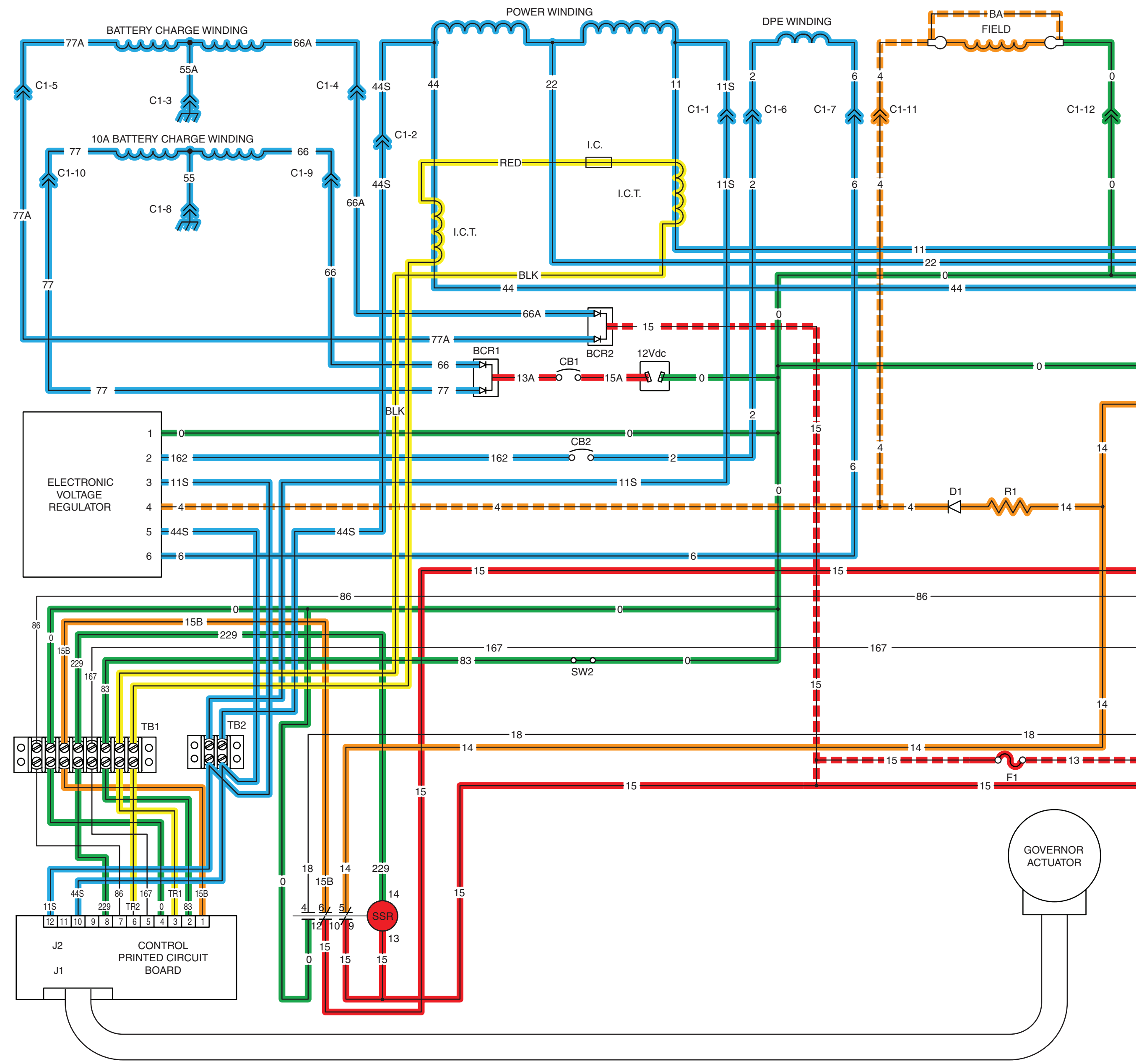



LEGEND
BA - BRUSH ASSEMBLY
BCR1 - BATTERY CHARGE RECTIFIER, 10A
BCR2 - BATTERY CHARGE RECTIFIER
CB1 - 10AMP AUTO RESET BREAKER
CB2 - 5AMP AUTO RESET BREAKER
D1 - 600V 12A DIODE
D2, D3 - ENGINE SHUTDOWN DIODE
F1 - 10A FUSE
FSS - FUEL SHUT OFF SOLENOID
GND - GROUND BAR
I.C.T. - IDLE CONTROL TRANSFORMER
IM1 - IGNITION MODULE, CYL. 1
IM2 - IGNITION MODULE, CYL. 2
LOP - LOW OIL PRESSURE
R1 - 25 OHM, 25W RESISTOR
SC - STARTER CONTACTOR
SCR - STARTER CONTACTOR RELAY
SM - STARTER MOTOR
SP1 - SPARK PLUG, CYL. 1
SP2 - SPARK PLUG, CYL. 2
SSR - START / STOP RELAY
SW1 - START-RUN-STOP SWITCH
SW2 - IDLE CONTROL SWITCH
TB1, TB2 - TERMINAL BLOCK

= 12 VDC SUPPLY
= 12 VDC CONTROL
= AC POWER
= GROUND

With the Start-Run-Stop Switch (SW1) held in the start position, Wire 15 is now connected to Wire 167. Wire 15 supplies fused battery power via Wire 167 to the Printed Circuit Board. This 12 VDC input signals the Printed Circuit Board to internally ground Wire 229 which is connected to the coil of the Start-Stop-Relay (SSR). This action allows current to flow and the SSR is energized. The normally open contacts close supplying battery power from Wire 15 to Wire 14. Wire 14 supplies power to the Fuel Shutoff Solenoid (FSS), it is energized and fuel is available to the engine. Wire 14 supplies power through Resistor (R1) and Diode (D1) to Wire 4, Wire 4 connects to the field or the Rotor assembly and is used as Field Boost. The second set of normally open contacts also close connecting Wire 15 12 VDC battery supply to Wire 15B. Wire 15B now supplies 12 VDC to the printed circuit board for use with the governor control system. The normally closed contacts now open, Wire 18 is no longer connected to Wire 0 and the magnetos are no longer grounded out and can produce spark.

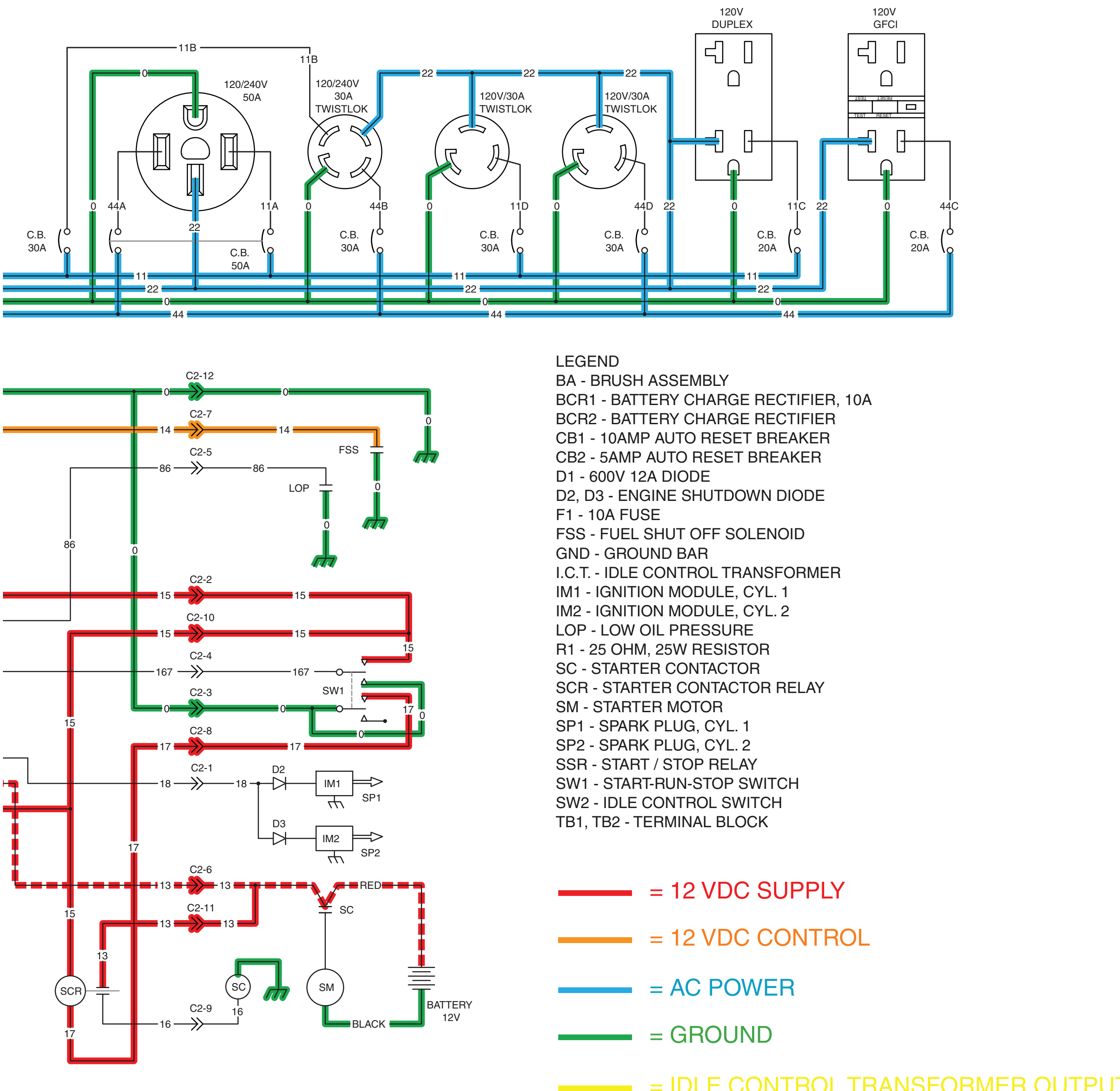



## *CIRCUIT CONDITION - RUN:*

Once the engine has started the Start-Run-Stop Switch (SW1) is released and will be in the run position, at this point SW1 is not activated. This action will de-energize the Starter Contactor Relay (SCR) causing the Starter Motor to disengage.

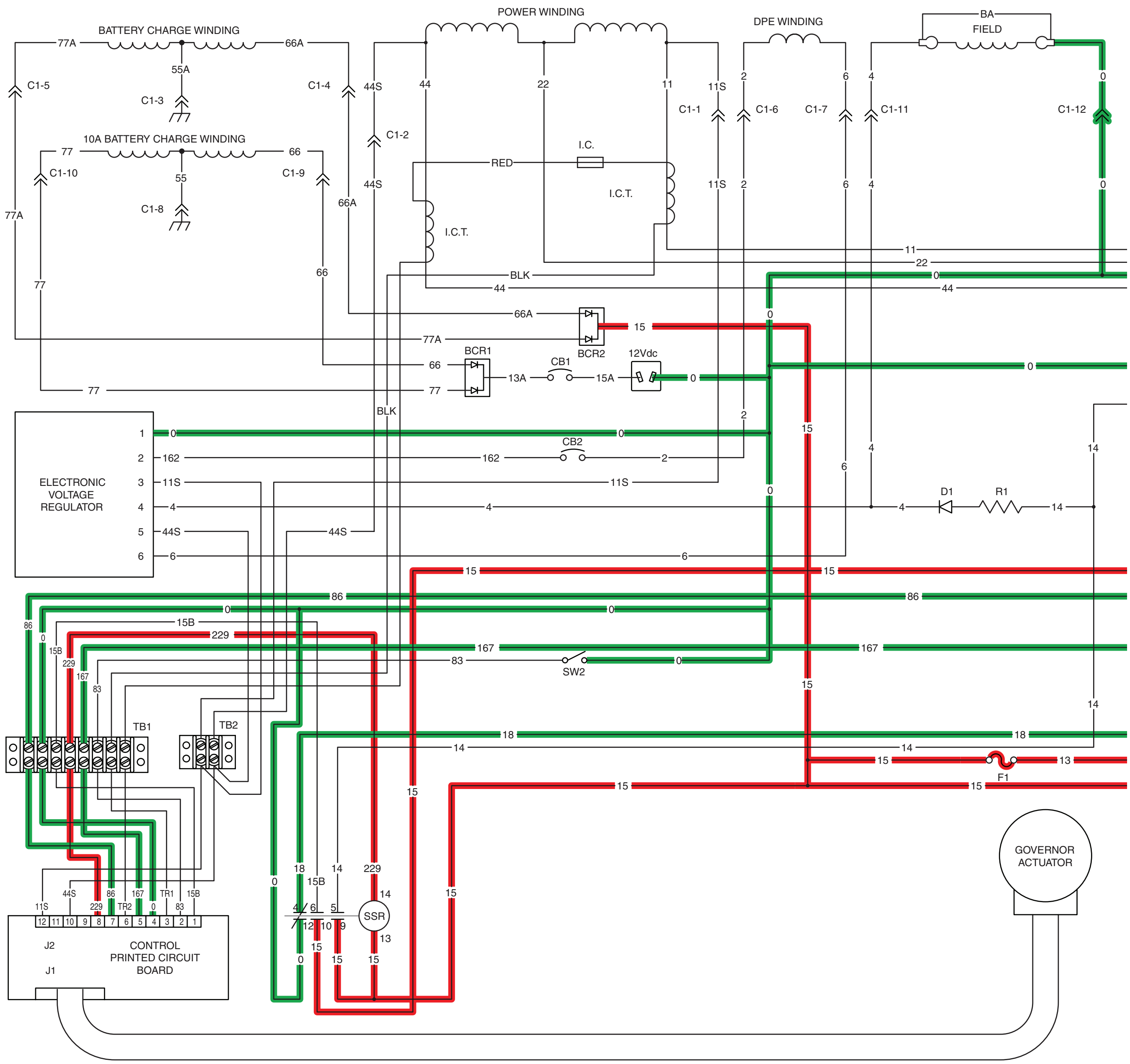
Printed circuit board action keeps Wire 229 held to ground this action holds the Start-Stop Relay (SSR) energized. With the SSR energized Wire 14 maintains 12 VDC to the Fuel Shutoff Solenoid. Once the Voltage Regulator starts functioning the field boost circuit is no longer a factor in operation. With the SSR energized Wire 15B maintains 12 VDC to the printed circuit board. With the SSR energized Wire 18 is not grounded and the magnetos continue to produce spark.

The two independent battery charge windings are now producing AC voltage and supplying this to BCR1 and BCR2. The AC voltage is rectified through BCR1 and used to supply DC voltage to the 12 VDC accessory outlet. The AC voltage is rectified through BCR2 and used to supply DC voltage to the battery for battery charging.



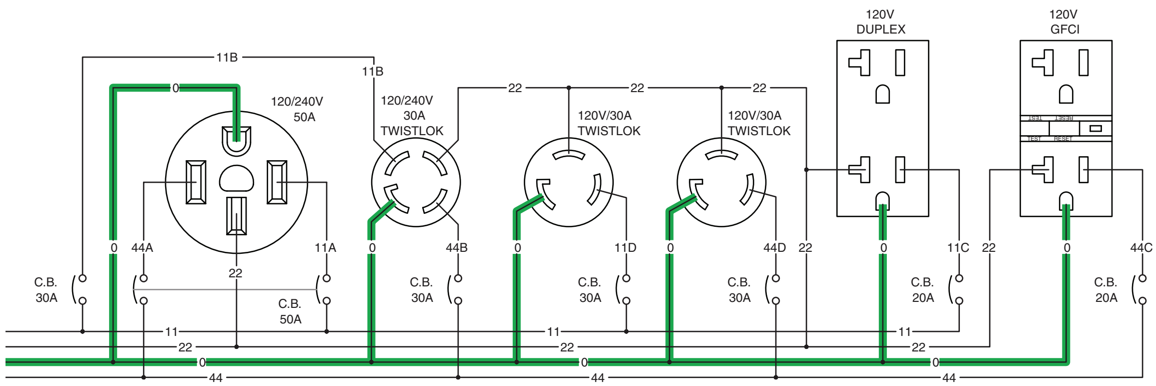

The printed circuit board is supplied with AC voltage from Wires 11S and 44S, this voltage /frequency signal is used by the printed circuit board for governor control operation.

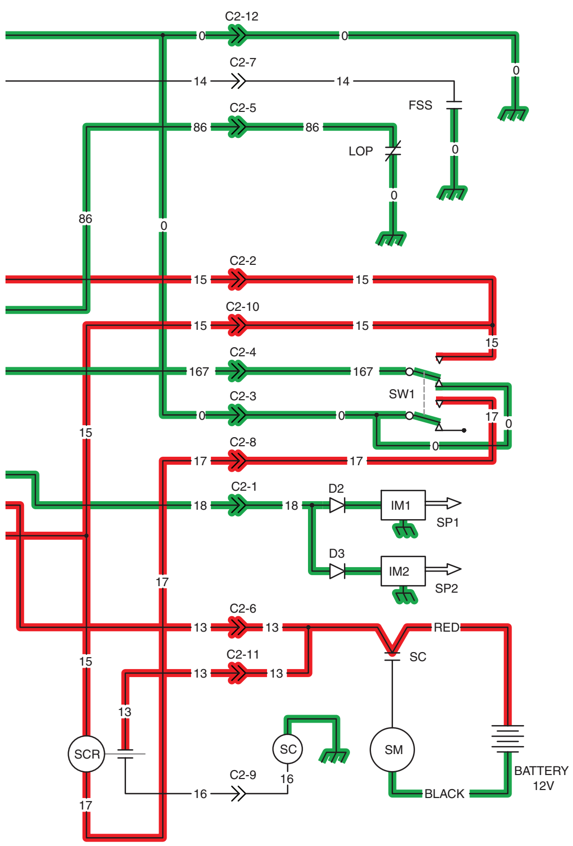
When the Idle Control Switch (SW2) is activated to the "ON" position Wire 83 from the printed circuit board will be connected to Wire 0 frame ground. There are two Idle Control Transformers (ICT) that sense current flow off the main power windings. The voltage signal from the ICT's connect to the Printed Circuit Board via Wires TR1/TR2 and are used for sensing load on the generator. With no-load on the generator there is no current supplied from the ICT's and the engine will run at a lower RPM. When a load is applied to the generator the ICT's supply a voltage signal to the Printed Circuit Board and the engine RPM will be increased to running RPM approximately 3600RPM.




## *CIRCUIT CONDITION - STOP:*

With the Start-Run-Stop Switch (SW1) placed in the Stop position Wire 167 is connected to Wire 0 which is frame ground. The ground signal is supplied via Wire 167 to the Printed Circuit Board. The Printed Circuit Board will open Wire 229 from ground; this action will de-energize the Start-Stop Relay (SSR). With the SSR de-energized Wire 14 will no longer have 12 VDC supplied to it through the relay, this de-energizes the Fuel Shutoff Solenoid (FSS) stopping fuel to the engine. With the SSR de-energized Wire 18 will now be connected to Wire 0, this action will ground the magnetos out through Wire 18 causing loss of spark to the engine. With the loss of fuel and loss of spark the engine will shutdown.




LEGEND
BA - BRUSH ASSEMBLY
BCR1 - BATTERY CHARGE RECTIFIER, 10A
BCR2 - BATTERY CHARGE RECTIFIER
CB1 - 10AMP AUTO RESET BREAKER
CB2 - 5AMP AUTO RESET BREAKER
D1 - 600V 12A DIODE
D2, D3 - ENGINE SHUTDOWN DIODE
F1 - 10A FUSE
FSS - FUEL SHUT OFF SOLENOID
GND - GROUND BAR
I.C.T. - IDLE CONTROL TRANSFORMER
IM1 - IGNITION MODULE, CYL. 1
IM2 - IGNITION MODULE, CYL. 2
LOP - LOW OIL PRESSURE
R1 - 25 OHM, 25W RESISTOR
SC - STARTER CONTACTOR
SCR - STARTER CONTACTOR RELAY
SM - STARTER MOTOR
SP1 - SPARK PLUG, CYL. 1
SP2 - SPARK PLUG, CYL. 2
SSR - START / STOP RELAY
SW1 - START-RUN-STOP SWITCH
SW2 - IDLE CONTROL SWITCH
TB1, TB2 - TERMINAL BLOCK

= 12 VDC SUPPLY
= 12 VDC CONTROL
= AC POWER
= GROUND

## *FAULT SHUTDOWN:*

With the generator running if the Low Oil Pressure (LOP) closes Wire 86 will be connected to Wire 0 frame ground. Printed Circuit Board action will open Wire 229 from ground; this action will de-energize the Start-Stop Relay (SSR). This action will cause a shutdown as described on Page 26.

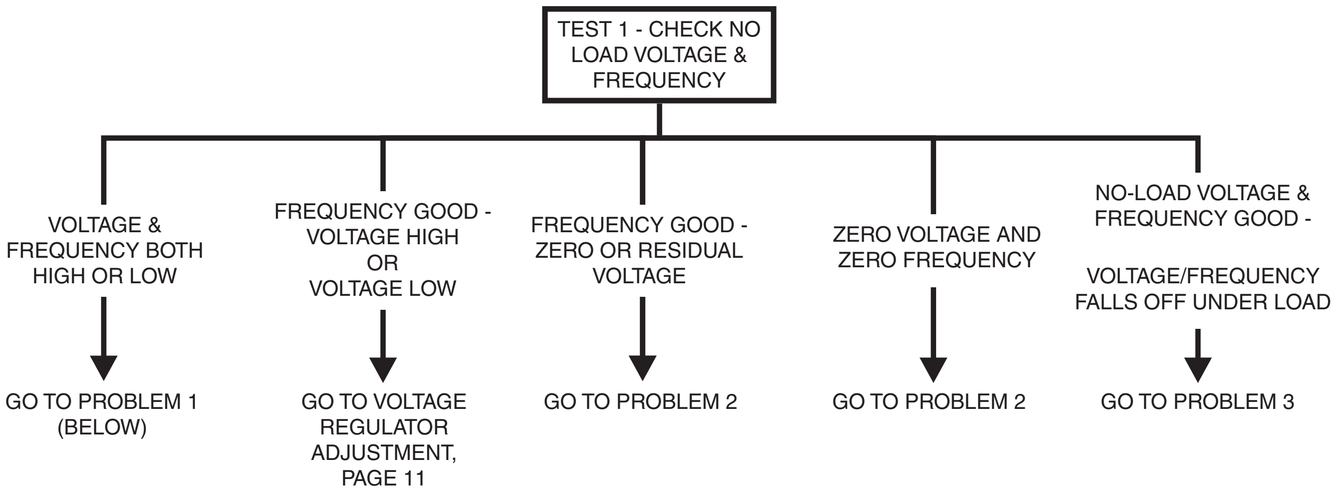
## INTRODUCTION

The "Flow Charts" in this section may be used in conjunction with the "Diagnostic Tests" of Section 6. Numbered tests in the Flow Charts correspond to identically numbered tests of Section 6.

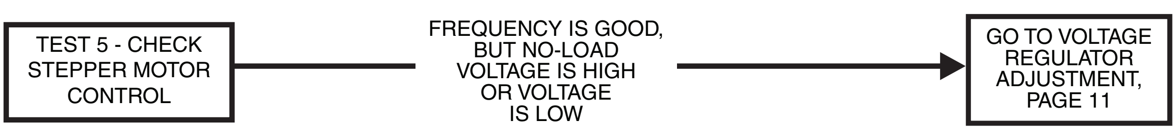
Problems 1 through 5 apply to the AC generator only.

Beginning with Problem 5, the engine DC control system is dealt with.

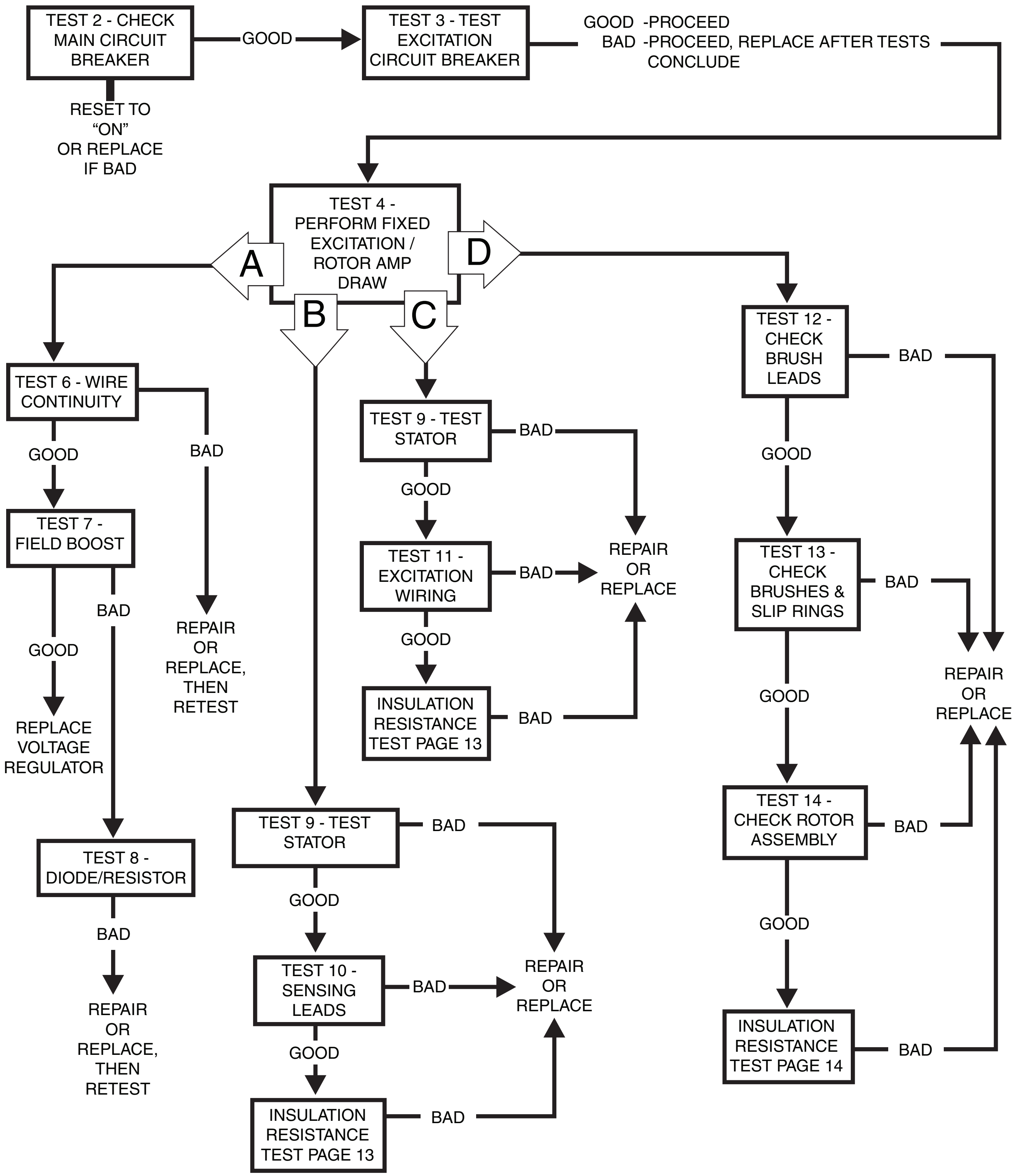
### If Problem Involves AC Output



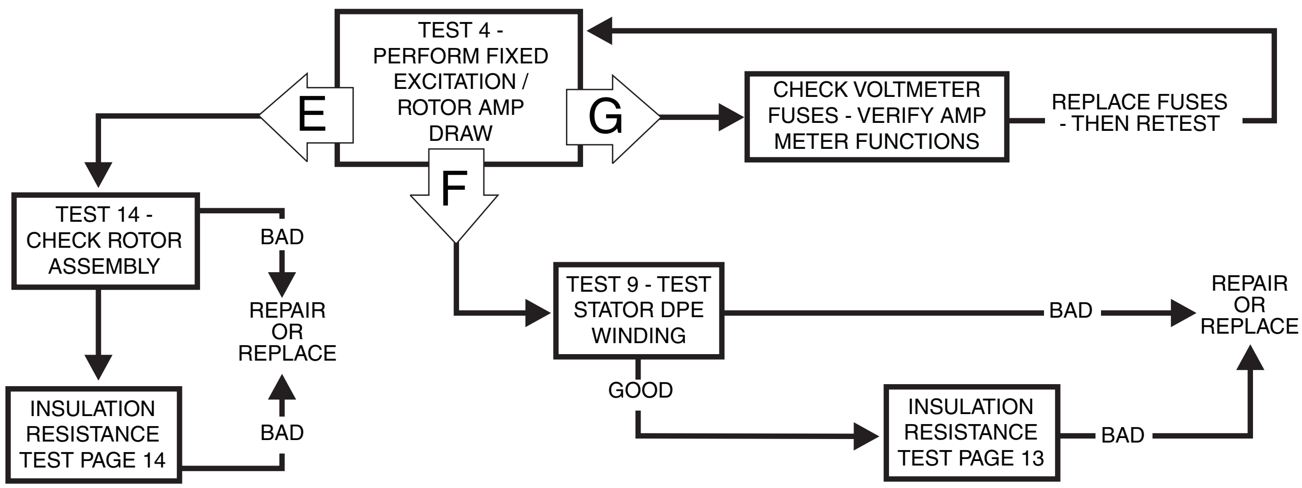

### Problem 1 - Voltage & Frequency Are Both High or Low



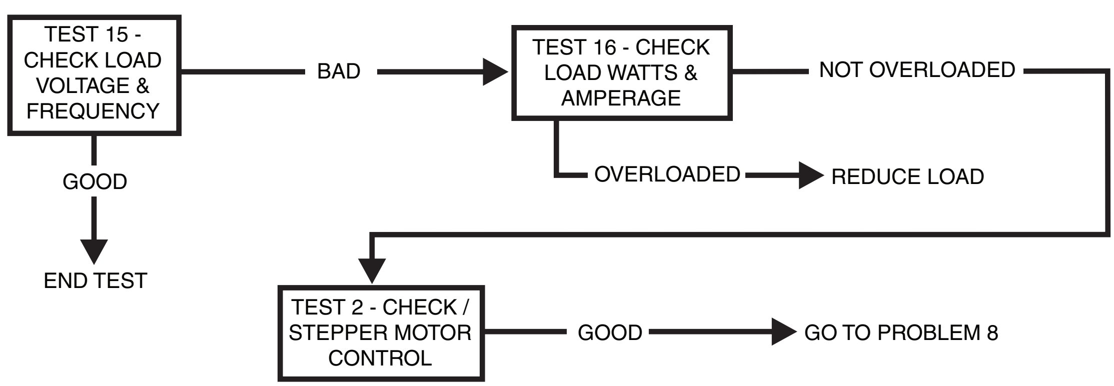
### *Problem 2 - Generator Produces Zero Voltage or Residual Voltage (2-12 VAC)*



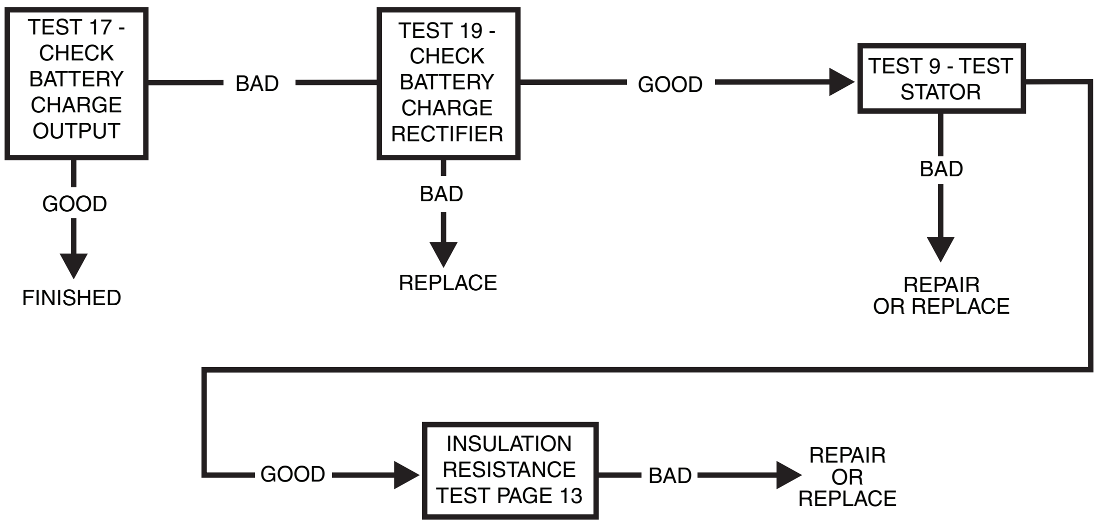
## *Problem 2 - Generator Produces Zero Voltage or Residual Voltage (2-12 VAC) (continued)*



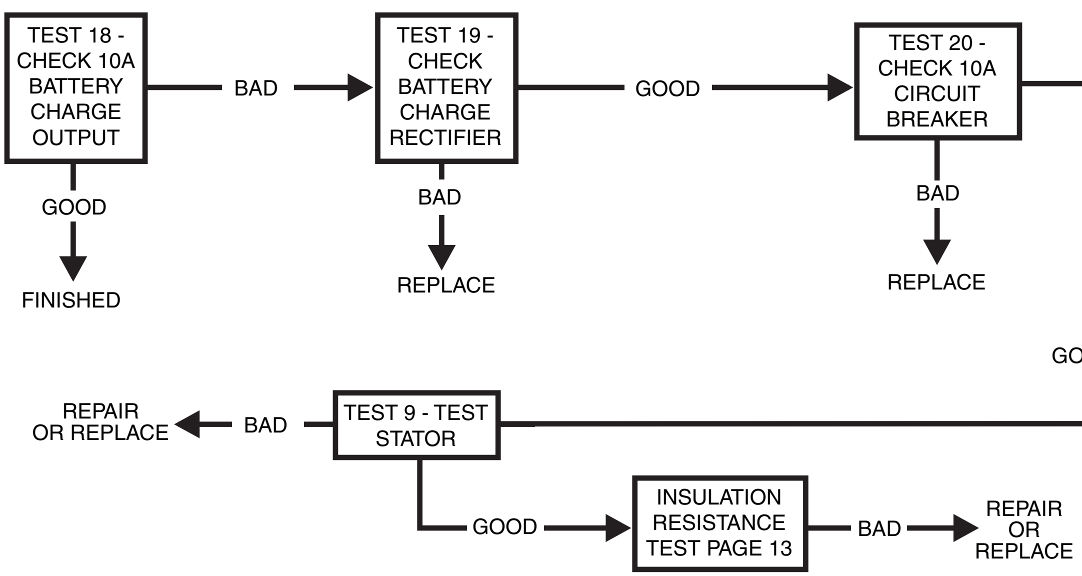

## *Problem 3 - Excessive Voltage/Frequency Droop When Load is Applied*



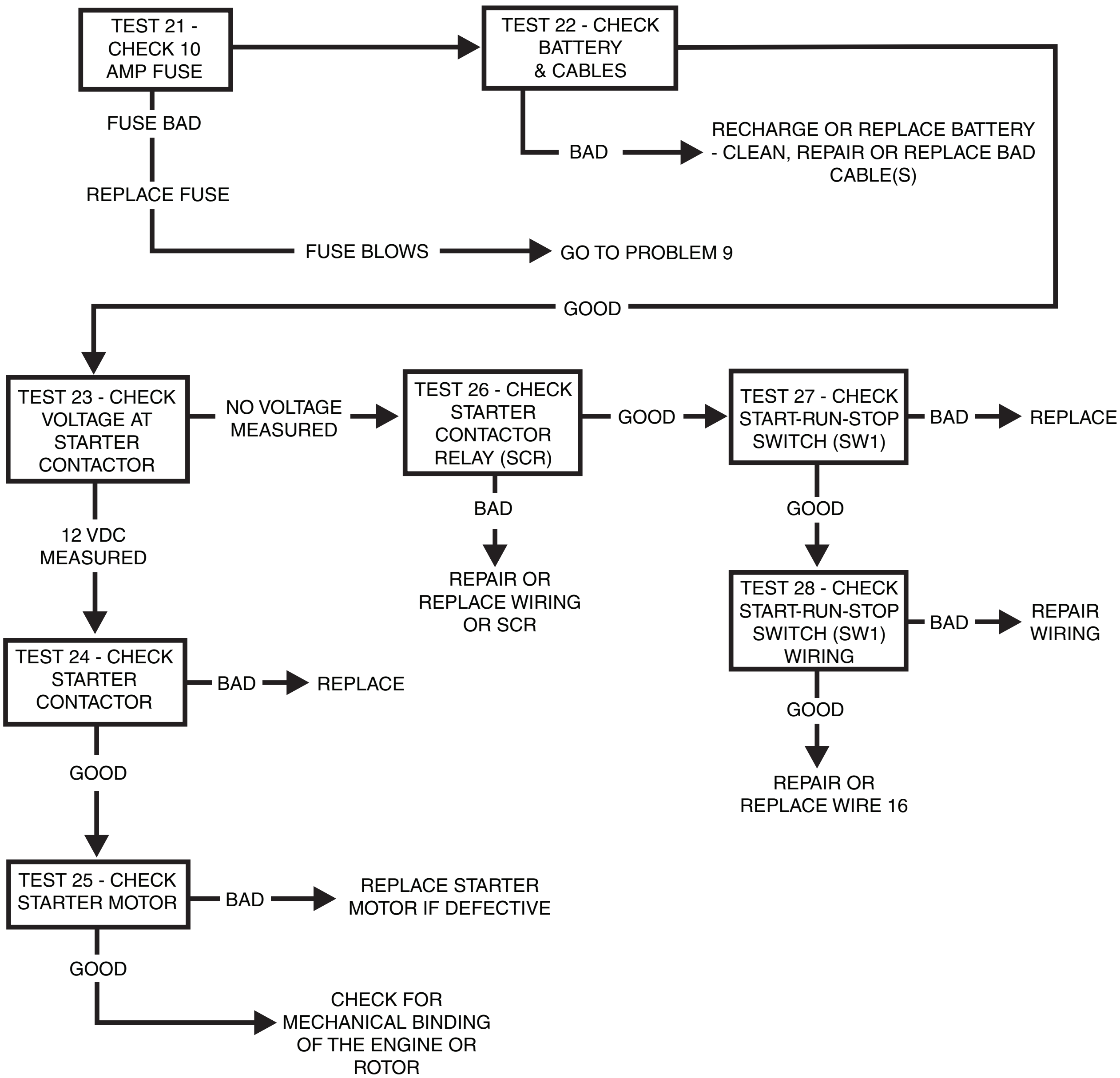
## *Problem 4 - No Battery Charge Output*



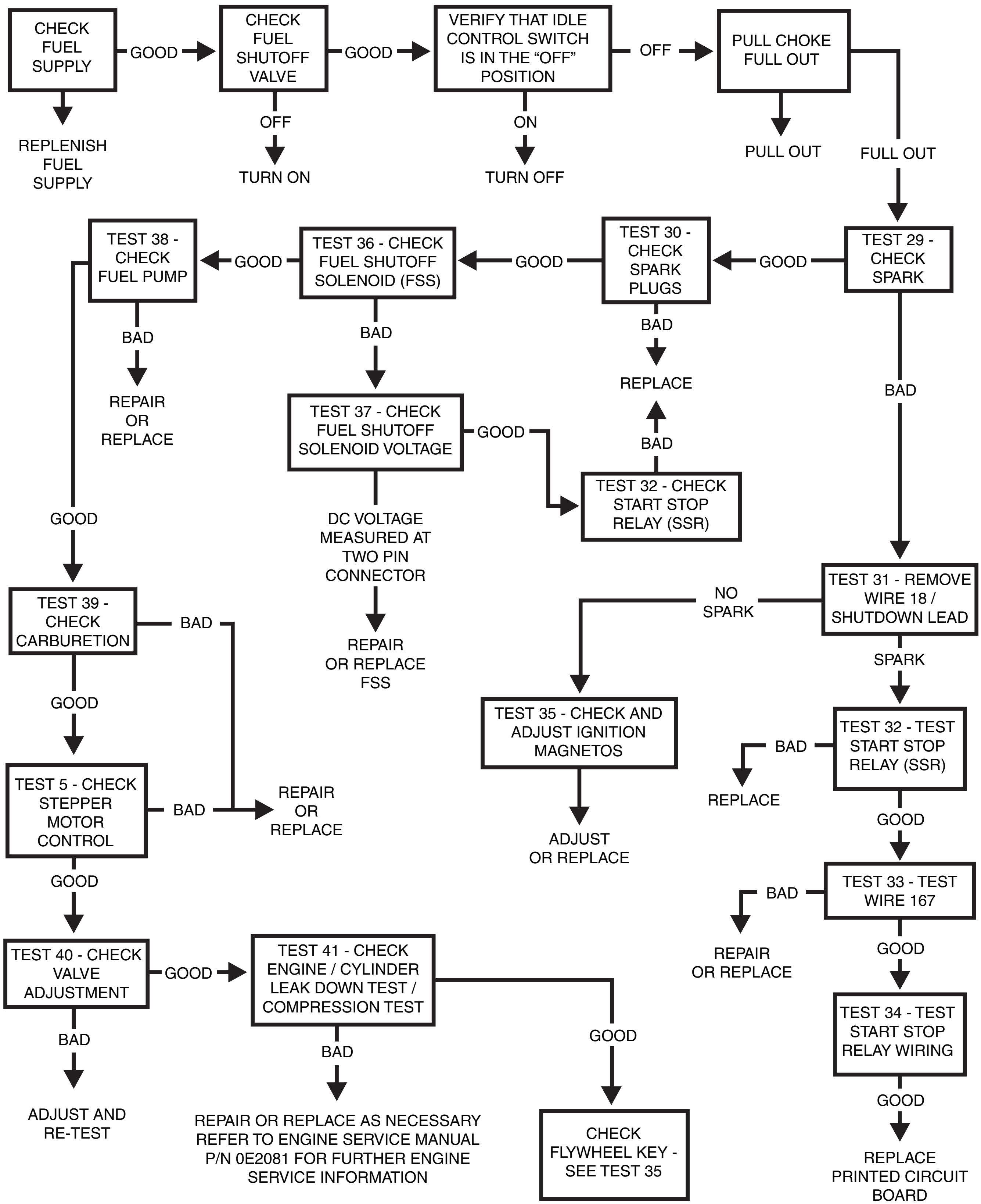

## *Problem 5 - No 10A Battery Charge Output*



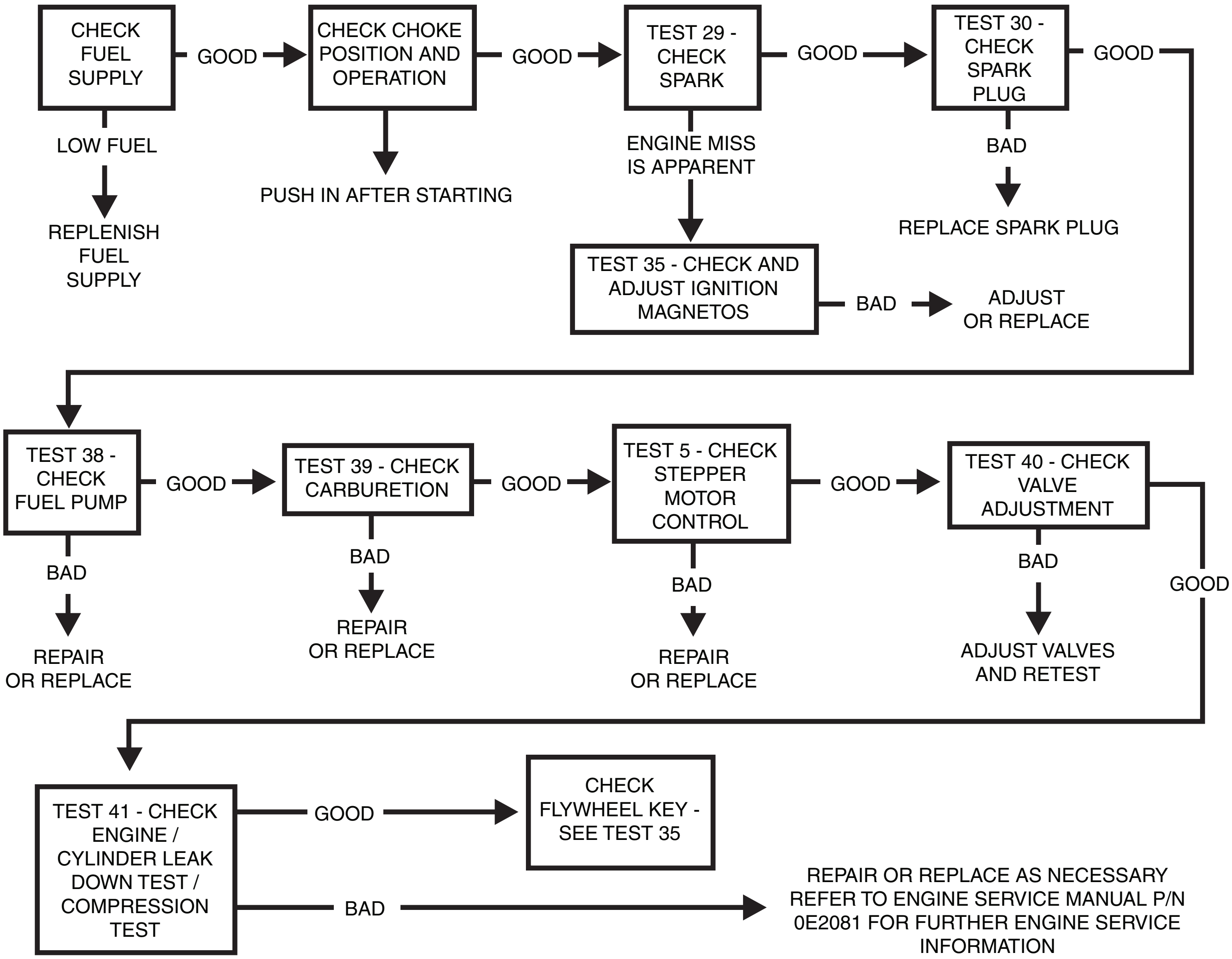
### *Problem 6 - Engine Will Not Crank*



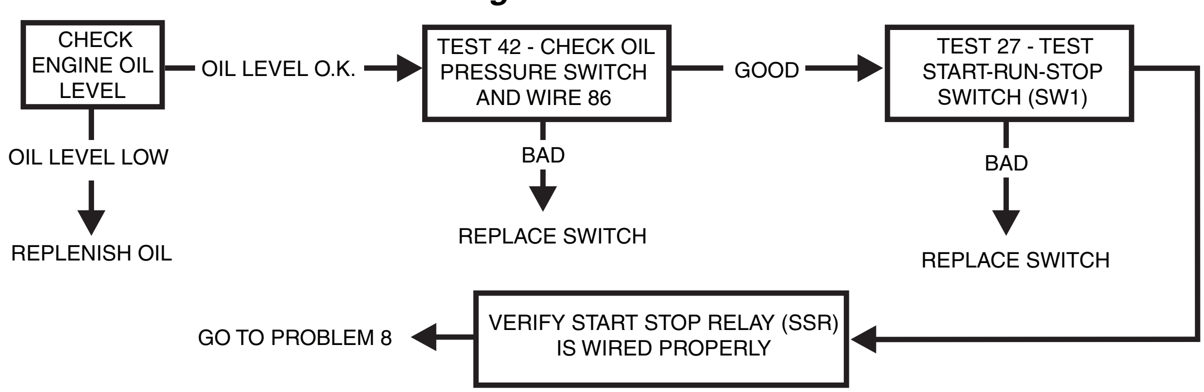
## *Problem 7 - Engine Cranks But Will Not Start*



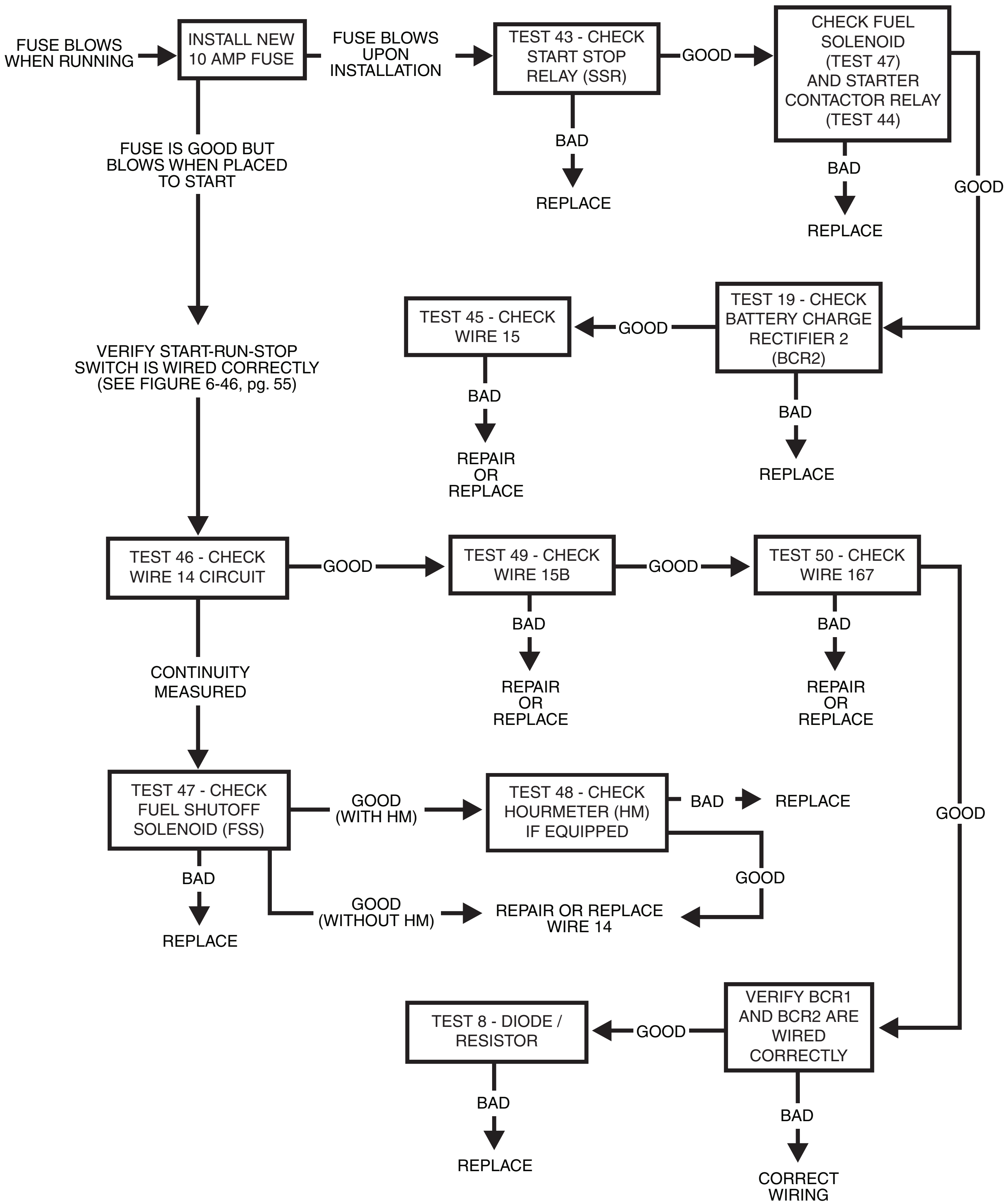
## *Problem 8 - Engine Starts Hard and Runs Rough*



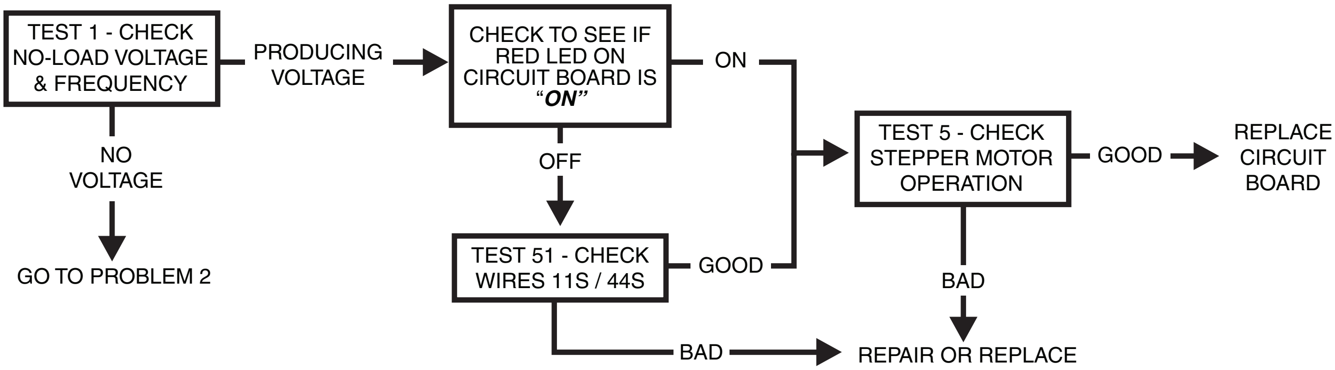

## *Problem 9 - Engine Starts Then Shuts Down*



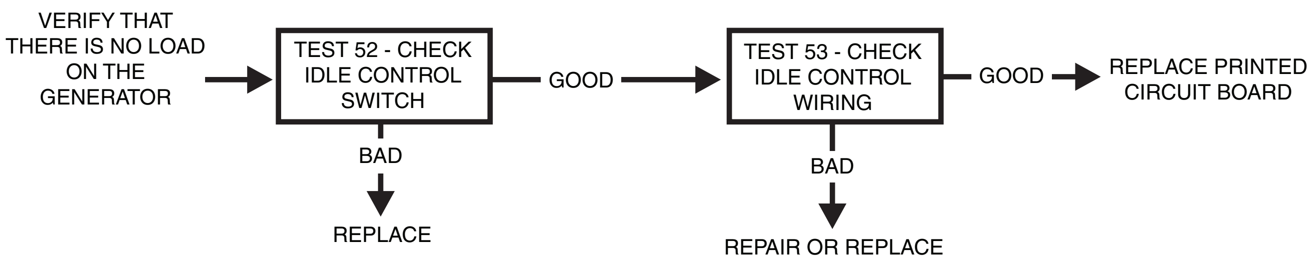
## *Problem 10 - 10 Amp Fuse (F1) Blowing*



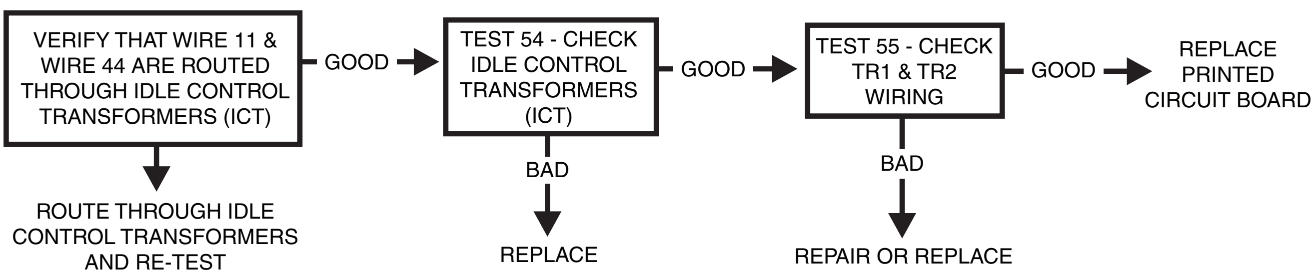
## *Problem 11 - Unit Overspeeds*




## *Problem 12 - Idle Control "RPM Does Not Decrease"*

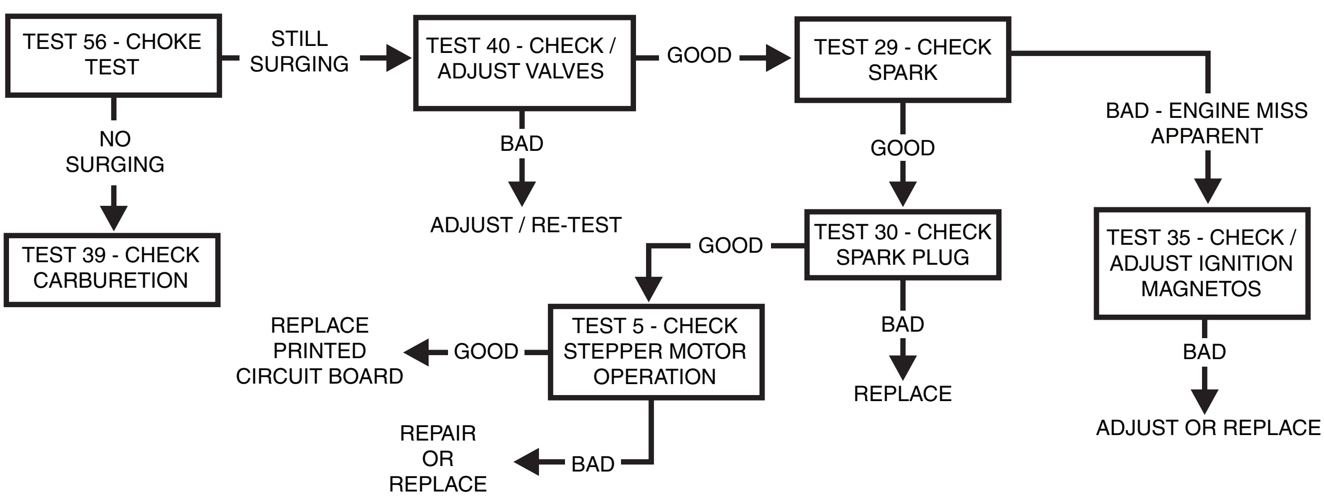



## *Problem 13 - Idle Control "RPM Does Not Increase When Load Is Applied"*




## *Problem 14 - Engine "Hunts" / Erratic Idle*

*Acceptable running limits for the engine are between 59-61 Hertz.



## INTRODUCTION

The “Diagnostic Tests” in this chapter may be performed in conjunction with the “Flow Charts” of Section 5. Test numbers in this chapter correspond to the numbered tests in the “Flow Charts”.

Tests 1 through 19 are procedures Involving problems with the generator's AC output voltage and frequency (Problems 1 through 5 in the “Flow Charts”).

Tests 19 through 54 are procedures involving problems with engine operation (Problems 6 through 14 in the “Troubleshooting Flow Charts”).

It may be helpful to read Section 2, “Measuring Electricity”.

***NOTE: Test procedures in this Manual are not necessarily the only acceptable methods for diagnosing the condition of components and circuits. All possible methods that might be used for system diagnosis have not been evaluated. If any diagnostic method is used other than the method presented in this Manual, the technician must ensure that neither his personal safety nor the product's safety will be endangered by the procedure or method that has been selected.***

## TEST 1 - CHECK NO-LOAD VOLTAGE AND FREQUENCY

PROCEDURE:

1. Disconnect or turn OFF all electrical loads connected to the generator.
2. Set a volt meter to measure AC voltage.
3. Reset all circuit breakers to the on position.
4. Turn the Idle Control switch to OFF.
5. Start the engine and let it stabilize and warm up.

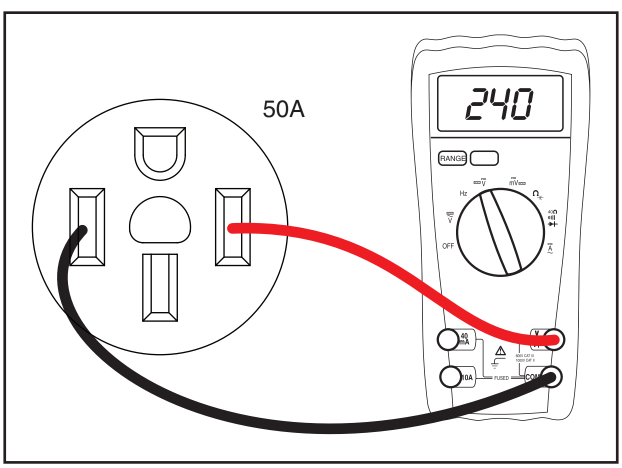



*Figure 6-1. – VOM Test Leads Connected to 50A Outlet*

****NOTE: If the generator is not producing AC Power, loss of governor control may occur causing an overspeed or extremely high RPM condition. If this condition occurs manually control throttle (60Hz /3600 RPM) to perform test.***

6. Place the meter test leads into the 50A outlet. See Figure 6-1.
7. Read the AC voltage.
8. Connect a AC frequency meter as described in Step 6.
9. Read the AC frequency.

RESULTS:

For units rated 60 Hertz, no load voltage and frequency should be approximately 238-242 VAC and 59-61 Hertz. See Flow Chart Problem 1.

## TEST 2 - CHECK MAIN CIRCUIT BREAKER

PROCEDURE:

The generator has seven circuit breakers located on the control panel. If outlets are not receiving power, make sure the breakers are set to ON or “Closed”.

If a breaker is suspected to have failed, it can be tested as follows (see Figure 6-7):

1. Set a Volt meter to measure resistance.
2. With the generator shut down, disconnect all wires from the suspected circuit breaker terminals to prevent interaction.
3. With the generator shut down, connect one meter test lead to a one terminal of the breaker and the other meter test lead to the other terminal. See Figure 6-7.
4. Set the breaker to its ON or “Closed” position. The meter should read CONTINUITY.
5. Set the breaker to its OFF or “Open” position and the meter should indicate INFINITY.

RESULTS:

1. If the circuit breaker tests good, refer back to the flow chart.
2. If the breaker tests bad, it should be replaced.

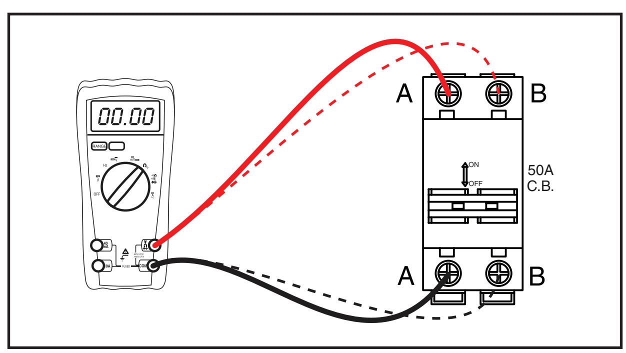



*Figure 6-7. – 50 Amp Breaker Test Points*

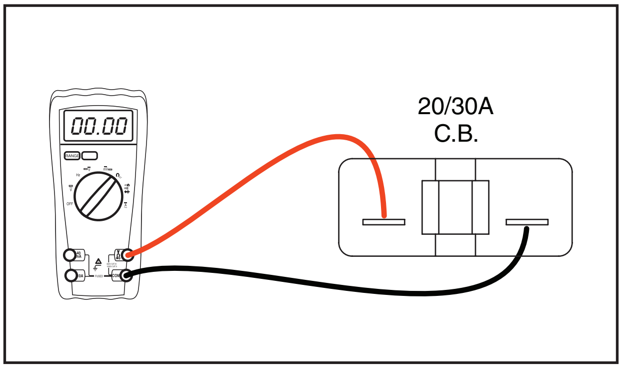



Figure 6-8. – 20/30 Amp Breaker Test Points

## TEST 3 - TEST EXCITATION CIRCUIT BREAKER

PROCEDURE:

1. With the generator shut down for at least two minutes, locate the Excitation Circuit Breaker in the control panel. Disconnect wires from the breaker, to prevent interaction.
2. Set a volt meter to measure resistance.
3. Connect the VOM test probes across the circuit breaker terminals. The meter should read CONTINUITY.

RESULTS:

1. If circuit breaker tests bad (meter reads “OPEN”) then proceed to Test 4 and replace the breaker after completing Test 4.
2. If circuit breaker is good, go on to Test 4.

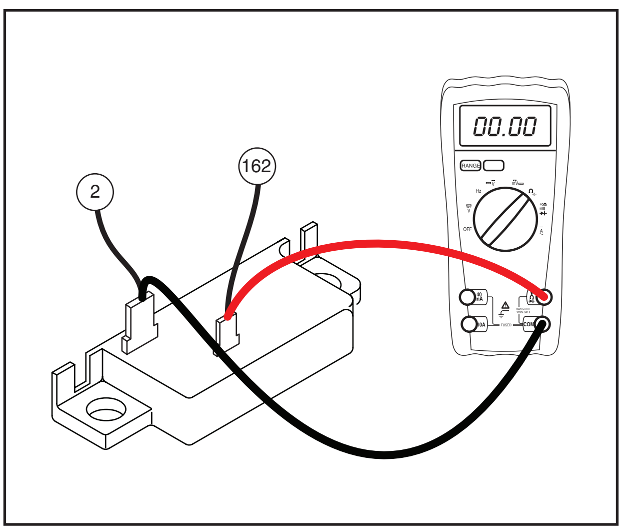



*Figure 6-9. - Testing Excitation Circuit Breaker*

## TEST 4 - FIXED EXCITATION TEST/ ROTOR AMP DRAW

PROCEDURE:

***NOTE: If the generator is not producing AC Power, loss of governor control may occur causing an overspeed or extremely high RPM condition. If this condition occurs manually control throttle (60Hz /3600 RPM) to perform test.***

1. Unplug the six pin connector at the Voltage Regulator.
2. Disconnect Wire 14 from the Resistor (R1).
3. Connect a jumper wire between the removed end of Wire 14 and Wire 4 where it is soldered at the Diode (D1). See Figure 6-10.

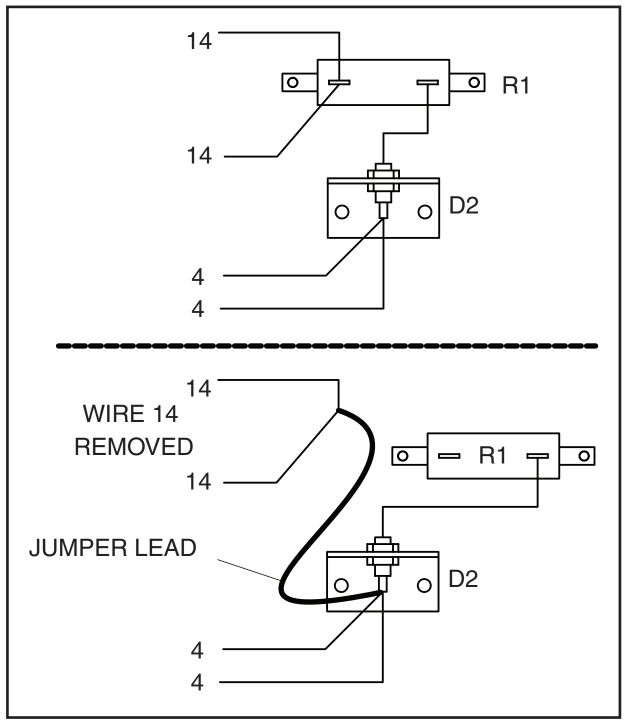



*Figure 6-10. – Jumper Lead From Wire 14 to Diode*

4. Set voltmeter to measure AC voltage
5. Disconnect Wire 2 from the Excitation Circuit Breaker and connect one meter test lead to it. Connect the other meter test lead to Wire 6 located in the six pin connector previously removed from the Voltage Regulator. Be careful not to damage the pin connectors with the test leads. See Figure 6-11.
6. Set Idle control switch to OFF.
7. Start the generator.
8. Measure the output voltage across Wire 2 and Wire 6 and record the results.

***AC Voltage across Wires 2 and 6 =*** ______________

9. Shutdown the generator.

10. Reconnect Wire 2 to the Excitation Circuit Breaker.

11. Connect one meter test lead to Wire 11S located in the six pin connector previously removed from the Voltage Regulator. Connect the other meter test lead to Wire 44S located in the six pin connector previously removed from the Voltage Regulator. See Figure 6-11. Be careful not to damage the pin connectors with the test leads.

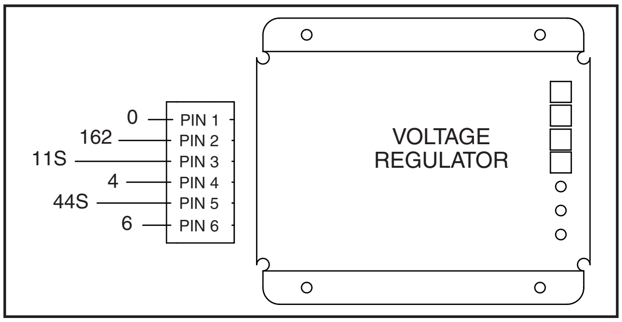



*Figure 6-11. - Voltage Regulator Pin Connector Wire Number Locations*

12. Start the generator.

13. Measure the output voltage across wires 11S and 44S and record the results.

***AC Voltage across Wires 11S and 44S=*** __________

14. Shutdown the generator.

15. Remove the Jumper lead between Wire 14 and Diode D1.

16. Set the voltmeter to measure DC amperage (10 Amp Range). Switch the test leads on the meter if required.

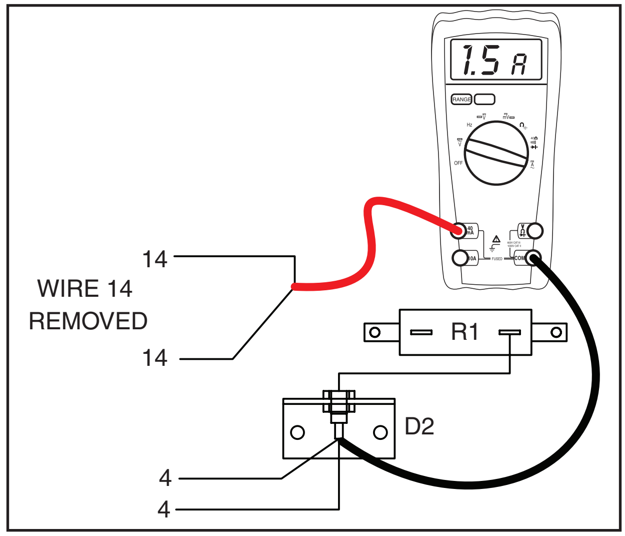



*Figure 6-12. – Measuring Amp Draw*

17. Connect the positive meter test lead to Wire 14. Connect the negative test lead to Wire 4 at Diode D1. See Figure 6-12.

18. Start the generator.

19. Measure the DC Rotor Amp draw and record the results.

***Rotor Amp Draw =***________________

20. Shutdown the generator.

21. Reconnect the six pin connector.

22. Reconnect Wire 14 to the resistor R1.

RESULTS:
Refer to "TEST 4 RESULTS" chart.

| TEST 4 RESULTS | | | | | | | |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G |
| VOLTAGE RESULTS WIRE 2 & 6 EXCITATION WINDING | ABOVE 60 VAC | ABOVE 60 VAC | BELOW 60 VAC | ZERO OR RESIDUAL VOLTAGE (2-12 VAC) | BELOW 60 VAC | BELOW 60 VAC | ABOVE 60 VAC |
| VOLTAGE RESULTS WIRE 11S & 44S | ABOVE 120 VAC | BELOW 120 VAC | ABOVE 120 VAC | ZERO OR RESIDUAL VOLTAGE (2-12 VAC) | BELOW 120 VAC | BELOW 120 VAC | ABOVE 120 VAC |
| ROTOR AMP DRAW 12.5 kW (MODEL 004451-0) (MODEL 004986-0) | 1.8 A ± 20% | 1.8 A ± 20% | 1.8 A ± 20% | ZERO CURRENT DRAW | ≥2.3 A | 1.8 A ± 20% | ZERO CURRENT DRAW |
| ROTOR AMP DRAW 15 kW (MODEL 004582-0,1) (MODEL 004987-0) (MODEL 005209-0) | 1.6 A ± 20% | 1.6 A ± 20% | 1.6 A ± 20% | ZERO CURRENT DRAW | ≥2.1 A | 1.6 A ± 20% | ZERO CURRENT DRAW |
| ROTOR AMP DRAW 15 kW (MODEL 004582-2) (MODEL 004987-1) | 0.96 A ± 20% | 0.96 A ± 20% | 0.96 A ± 20% | ZERO CURRENT DRAW | ≥1.5 A | 0.96 A ± 20% | ZERO CURRENT DRAW |
| ROTOR AMP DRAW 17.5 kW (MODEL 004583-0) (MODEL 005308-0) | 0.89 A ± 20% | 0.89 A ± 20% | 0.89 A ± 20% | ZERO CURRENT DRAW | ≥1.4 A | 0.89 A ± 20% | ZERO CURRENT DRAW |
| **(MATCH RESULTS WITH LETTER AND REFER TO FLOW CHART – Problem 2 on Pages 29 & 30)** | | | | | | | |

## TEST 5 - CHECK STEPPER MOTOR CONTROL

PROCEDURE:

1. Remove air cleaner cover to access stepper motor.
2. Physically grab the throttle and verify the stepper motor, linkage and throttle do not bind in any way, if any binding is felt repair or replace components as needed. Some resistance should be felt as the stepper motor moves through it's travel.
3. Physically move the throttle to the closed position by pushing the throttle down as looking from above.
   a. Place the idle control switch to off.
   b. Place the start switch to start and watch for stepper motor movement it should move to the wide open position during cranking. Once the unit starts the stepper motor should move the throttle to a position to maintain 60 Hertz.

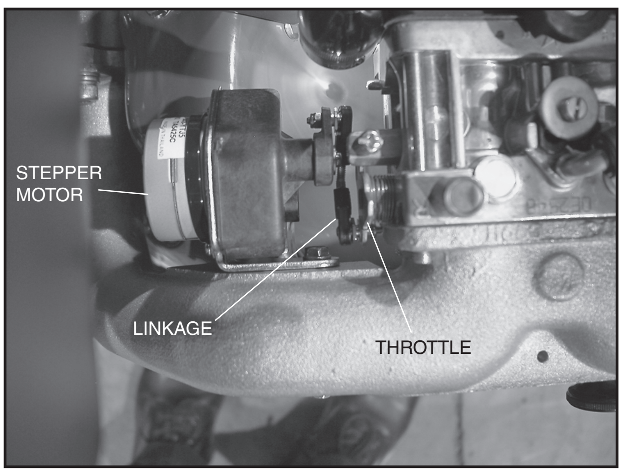



*Figure 6-2. – Stepper Motor, Linkage and Throttle Seen From Above*

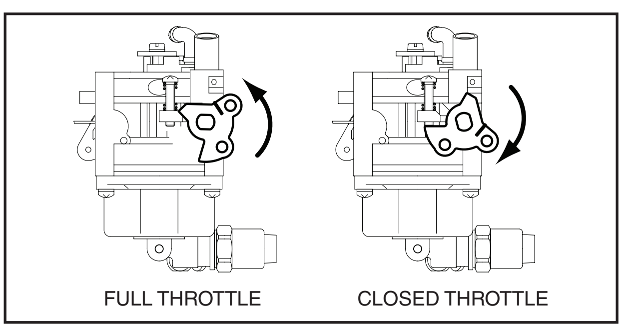



*Figure 6-3. – Throttle Positions*

4. If no movement is seen in Step 3 remove the control panel cover. Verify the six pin connector on the printed circuit board is seated properly, remove the connector and then replace it and test again. Verify the switches are correctly set. See Figure 4-1 on Page 16 for positioning.
5. If problem continues remove six pin connector from printed circuit board. Set Volt meter to measure ohms. Carefully measure from the end of the six pin harness as follows:

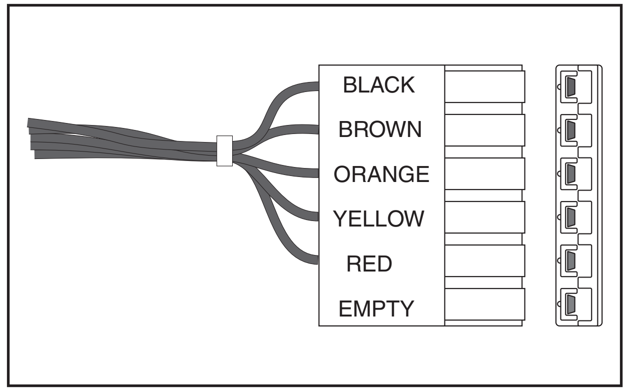



*Figure 6-4. – Six Pin Connector Wire Colors*

***NOTE: Press down with the meter leads on the connectors exposed terminals, do not probe into the connector.***

   a. Connect one meter lead to Red, connect the remaining test lead to Orange, approximately 10 ohms should be measured.
   b. Connect one meter lead to Red, connect the remaining test lead to Yellow, approximately 10 ohms should be measured.
   c. Connect one meter lead to Red, connect the remaining test lead to Brown, approximately 10 ohms should be measured.
   d. Connect one meter lead to Red, connect the remaining test lead to Black, approximately 10 ohms should be measured.
   e. Connect one meter lead to Red, connect the remaining test to the stepper motor case. No resistance should be measured INFINITY or Open"

See Figure 6-4.

6. Set a voltmeter to measure DC voltage.
7. Connect the positive meter test lead to Wire 15B at Terminal Block 1 (TB1). Connect the negative meter test lead to ground. See Figure 6-5. Place the Start-Run-Stop Switch (SW1) to START. 12 VDC should be measured. If voltage was measured proceed to Step 8. If voltage was not measured, proceed to "RESULTS".
8. Set a voltmeter to measure resistance.
9. Disconnect the J2 connector from the printed circuit board. Connect one meter test lead to Pin Location J2-1 (Wire 15B. Connect the other meter test lead to Wire 15B at Terminal Block 1 (TB1). See Figure 6-6. Continuity should be measured.

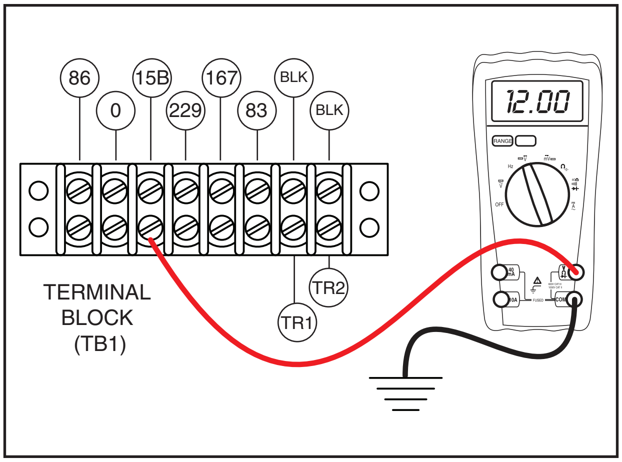



*Figure 6-5. – Testing Wire 15B*

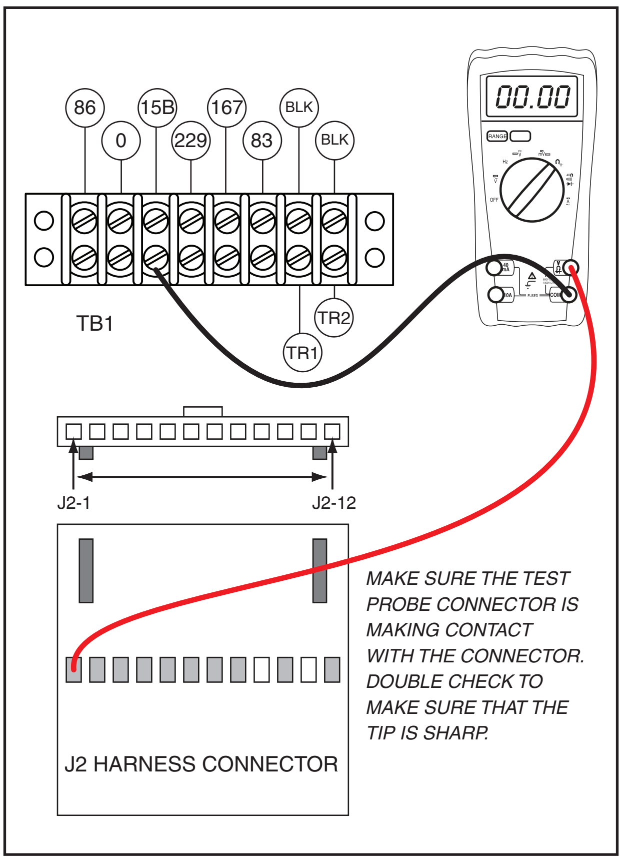



*Figure 6-6. – Testing J2-1*

RESULTS:

1. If the stepper motor fails any part of Step 5 replace the stepper motor.
2. If Step 7 fails repair or replace Wire 15B between the Start-Run-Stop Relay (SSR) and Terminal Block TB1.
3. If the stepper motor passes all steps replace the Printed Circuit Board.

## *TEST 6 - WIRE CONTINUITY*

PROCEDURE:

1. Set a Voltmeter to measure resistance.
2. Remove the six pin connector from the Voltage Regulator.
3. Connect one meter test lead to Wire 0 in the six pin connector previously removed from the Voltage Regulator. See Figure 6-11. Be careful not to damage the pin connectors with the test leads.
3. Connect the other test lead to the ground terminal in the control panel. The meter should read continuity.
4. Connect one meter test lead to Wire 162 in the six pin connector previously removed from the Voltage Regulator. See Figure 6-11. Be careful not to damage the pin connectors with the test leads.
5. Remove Wire 162 from the Excitation Circuit Breaker (CB1). Connect the other meter test lead to Wire 162. The meter should read continuity.

RESULTS:

If continuity was NOT measured across each wire, repair or replace the wires as needed. If continuity WAS measured refer back to flow chart.

## *TEST 7 - CHECK FIELD BOOST*

PROCEDURE:

1. Set VOM to measure DC voltage.
2. Disconnect the six pin connector from the Voltage Regulator.
3. Disconnect Connector C1. See Page 17 for connector location.
4. Disconnect Wire 16 from the Starter Contactor Relay (SCR). See Figure 6-13. This will cause the unit not to crank when placed in the Start position.
5. Connect the positive meter test lead to Wire 4 at the diode (D1), Wire 4 is soldered to the diode. See Figure 6-14. Connect the negative meter test lead to the ground terminal.
6. Set the Start-Run-Stop Switch (SW1) to START. Measure the DC voltage. It should read approximately 12 VDC.
7. Reconnect the Six Pin connector to the Voltage Regulator, Reconnect the C1 connector, and reconnect Wire 16 to the Starter Contactor Relay.

RESULTS:

1. If 12 VDC was measured in Step 5 the field boost circuit is working refer back to the flow chart.
2. If field boost voltage was not measured refer back to the flow chart.

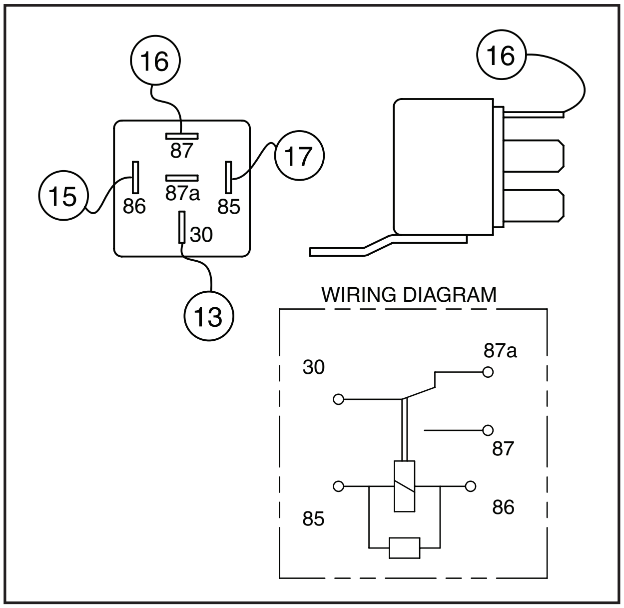



*Figure 6-13. – Starter Contactor Relay*

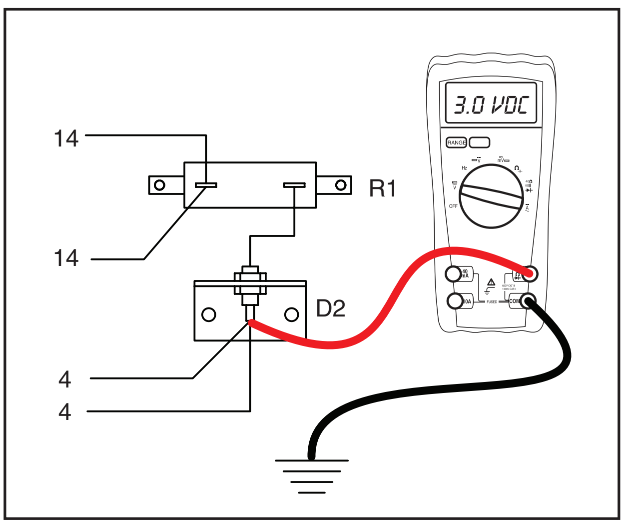



*Figure 6-14. – Testing Field Boost*

## TEST 8 - DIODE/RESISTOR

PROCEDURE:

1. Set volt meter to the diode test range.
2. Disconnect the six pin connector from the Voltage Regulator.
3. Disconnect Connector C1. See Page 17 for connector location.
4. Disconnect both wires from the Resistor (R1).
5. Connect the positive meter test lead to the top terminal of the diode (D1). Connect the negative meter test lead to the bottom of the diode (D1). See Figure 6-15. INFINITY or an open condition should be measured.

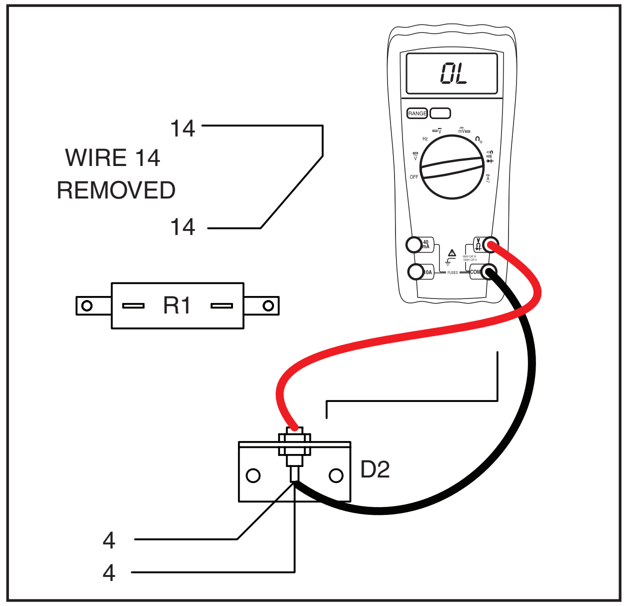



*Figure 6-15. – Diode Test Step 5*

6. Connect the positive meter test lead to the bottom terminal of the diode (D1). Connect the negative meter test lead to the top of the diode (D1). Approximately 0.5 Volts should be measured.

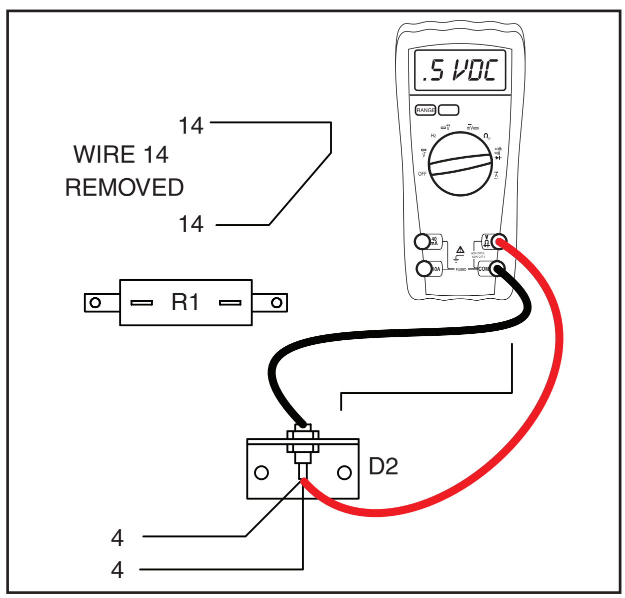



*Figure 6-16. – Diode Test Step 6*

7. Set volt meter to measure resistance.
8. Connect one meter test lead to the top terminal of the diode (D1). Connect the other meter test lead to the ground terminal. INFINITY or an open condition should be measured.
9. Connect one meter test lead to one terminal of the resistor (R1). Connect the other meter lead to the remaining terminal of resistor (R1). See Figure 6-17. Approximately 25 ohms should be measured.

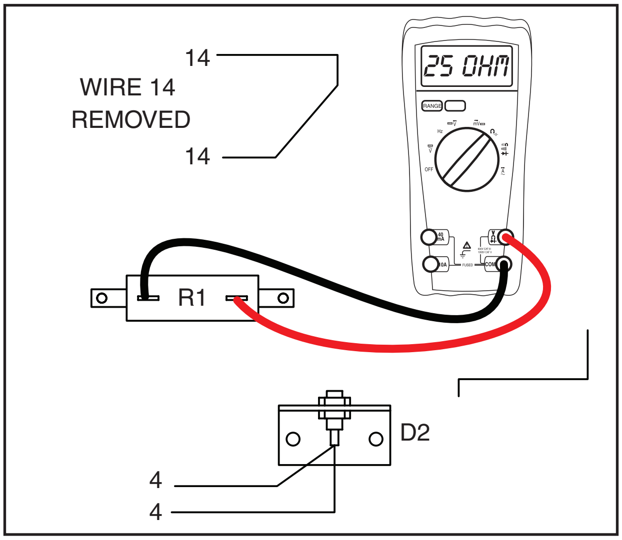



Figure 6-17. – Diode Test Step 9

10. Connect one meter test lead to the top terminal of the resistor (R1). Connect the other meter test lead to the ground terminal. INFINITY or an open condition should be measured.

11. Reconnect the six pin connector, reconnect the C1 connector, reconnect the two wires removed from the resistor (R1).

RESULTS:

1. If the diode or resistor failed any step it should be replaced.

## *TEST 9 - TEST STATOR*

PROCEDURE:

1. From the 50 Amp circuit breaker, disconnect Wires 11 and 44.

2. From the 50 Amp receptacle disconnect Wire 22.

3. Disconnect Connector C1. See Page 17 for connector location.

4. Set a voltmeter to measure resistance.

5. Connect the meter test leads across Stator leads 11 and 22. Normal power winding resistance should be read.

6. Connect the meter test leads across Stator leads 44 and 22. Normal power winding resistance should be read.

7. Connect the meter test leads across Stator leads 11S (Pin 1) and Stator lead 44S (Pin 2) at the C1 connector female side. See Figure 6-18. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. Normal power winding resistance should be read.

8. Connect the meter test leads across Stator leads 66A (Pin 4) and Stator lead 77A (Pin 5) at the C1 connector female side. See Figure 6-18. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. Normal battery charge winding resistance should be read.

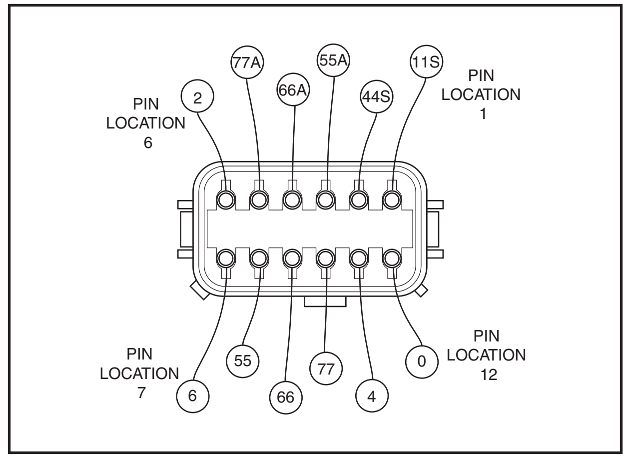



Figure 6-18. – C1 Connector, Female Side

9. Connect the meter test leads across Stator leads 2 (Pin 6) and Stator lead 6 (Pin 7) at the C1 connector female side. See Figure 6-18. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. Normal excitation winding resistance should be read.

10. Connect the meter test leads across Stator leads 66 (Pin 9) and Stator lead 77 (Pin 10) at the C1 connector female side. See Figure 6-18. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. Normal 10 Amp battery charge winding resistance should be read.

| Winding | Wire Numbers | Models 004451-0 004986-0 | Models 004582-0,1 004987-0 005209-0 | Models 004582-2 004987-1 | Models 004583-0 005308-0 |
|---|---|---|---|---|---|
| Power | 11 & 22 | 0.125 | 0.088 | 0.088 | 0.067 |
| Power | 44 & 22 | 0.125 | 0.088 | 0.089 | 0.067 |
| Sensing | 11S & 44S | 0.25 | 0.176 | 0.176 | 0.134 |
| Excitation | 2 & 6 | 0.576 | 0.546 | 1.270 | 1.010 |
| Battery Charge | 66A & 77A | 0.132 | 0.111 | 0.111 | 0.103 |
| 10A Battery Charge | 66 & 77 | 0.145 | 0.125 | 0.125 | 0.117 |

* Resistance values In ohms at 20° C. (68° F.). Actual readings may vary depending on ambient temperature. A tolerance of plus or minus 5% is allowed.

11. Connect the meter test leads across Stator lead 11 and frame ground. INFINITY should be read.

10. Connect the meter test leads across Stator lead 66A (Pin 4) and Stator lead 2 (Pin 6) at the C1 connector female side and frame ground. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. See Figure 6-18. INFINITY should be read.

12. Connect the meter test leads across Stator lead 2 (Pin 6) at the C1 connector female side and frame ground. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. See Figure 6-18. INFINITY should be read.
13. Connect the meter test leads across Stator lead 66 (Pin 9) at the C1 connector female side and frame ground. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. See Figure 6-18. INFINITY should be read.
14. Connect the meter test leads across Stator leads Wire 11 and Stator lead 66A (Pin 4) at the C1 connector female side. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. See Figure 6-18. INFINITY should be read.
15. Connect the meter test leads across Stator leads Wire 11 and Stator lead 2 (Pin 6) at the C1 connector female side. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. See Figure 6-18. INFINITY should be read.
16. Connect the meter test leads across Stator leads Wire 11 and Stator lead 66 (Pin 9) at the C1 connector female side. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. See Figure 6-18. INFINITY should be read.
17. Connect the meter test leads across Stator lead 66A (Pin 4) and Stator lead 2 (Pin 6) at the C1 connector female side. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. See Figure 6-18. INFINITY should be read.
18. Connect the meter test leads across Stator lead 66A (Pin 4) and Stator lead 66 (Pin 9) at the C1 connector female side. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. See Figure 6-18. INFINITY should be read.
19. Connect the meter test leads across Stator lead 2 (Pin 6) and Stator lead 66 (Pin 9) at the C1 connector female side. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. See Figure 6-18. INFINITY should be read.

RESULTS:

If the stator fails any step replace it, for Steps 1-10 keep in mind resistance values may vary depending on ambient temperature and calibration of the meter used. If the stator passes all tests refer back to the flow chart.

## *TEST 10 - SENSING LEADS*

PROCEDURE:

1. Set a VOM to measure resistance.
2. Disconnect Connector C1. See Page 17 for connector location.
3. Locate the male side of the connector located on the bottom of the control panel. See Figure 6-19. Connect one meter test lead to Pin 1 Wire 11S. It may be helpful to connect a small jumper lead to the individual pin. Connect the other meter test lead to Wire 11S at Terminal Block 2 (TB2) . See Page 17 for Terminal Block 2 location. Continuity should be measured.

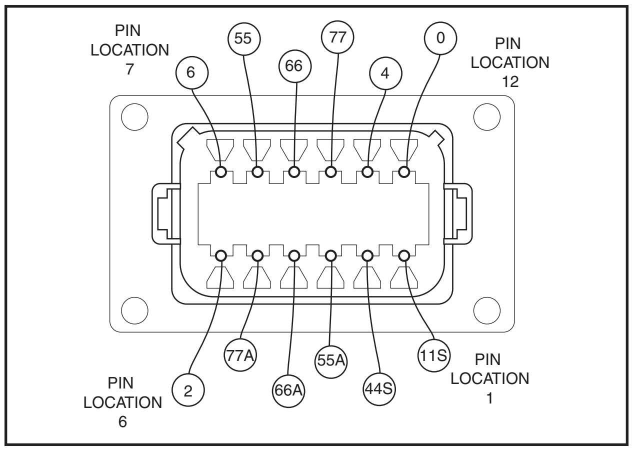



*Figure 6-19. – C1 Connector, Male Side*

4. Locate the male side of the connector located on the bottom of the control panel. See Figure 6-19. Connect one meter test lead to Pin 2 Wire 44S. It may be helpful to connect a small jumper lead to the individual pin. Connect the other meter test lead to Wire 44S at Terminal Block 2 (TB2). Continuity should be measured.
5. Unplug the six pin connector at the Voltage Regulator.
6. Connect the one meter test lead to Wire 11S at Terminal Block 2 (TB2). Connect the other meter test lead to Wire 11S at the six pin connector previously removed from the Voltage Regulator. See Figure 6-11. Be careful not to damage the pin connectors with the test leads. Continuity should be measured.
7. Connect the one meter test lead to Wire 44S at Terminal Block 2 (TB2). Connect the other meter test lead to Wire 44S at the six pin connector previously removed from the Voltage Regulator. See Figure 6-11. Be careful not to damage the pin connectors with the test leads. Continuity should be measured.

RESULTS:

1. If continuity was not measured in any of the steps repair or replace wire.
2. If all steps pass refer back to flow chart.

## TEST 11 - EXCITATION WIRING

PROCEDURE:

1. Set a voltmeter to measure resistance.
2. Disconnect Connector C1. See Page 17 for connector location.
3. Locate the male side of the connector located on the bottom of the control panel. See Figure 6-19. Connect one meter test lead to Pin 6 Wire 2, it may be helpful to connect a small jumper lead to the individual pin. Disconnect Wire 2 from the Excitation Circuit Breaker (CB1). Connect the other meter test lead to Wire 2 . See Page 17 for Excitation Circuit Breaker location. Continuity should be measured.
4. Unplug the six pin connector at the Voltage Regulator.
5. Locate the male side of the C1 connector located on the bottom of the control panel. Connect one meter test lead to Pin 7, Wire 6. It may be helpful to connect a small jumper lead to the individual pin. Connect the other meter Test lead to Wire 6 located in the six pin connector previously removed from the Voltage Regulator. Be careful not to damage the pin connectors with the test leads. Continuity should be measured.

RESULTS:

1. If continuity was not measured in any of the steps repair or replace wire.
2. If all steps pass refer back to flow chart.

## TEST 12 - CHECK BRUSH LEADS

PROCEDURE:

1. Set a voltmeter to measure resistance.
2. Disconnect Connector C1. See Page 17 for connector location.
3. See Figure 6-18. Connect the meter test leads across Wire 4 (Pin 11) and Wire 0 (Pin 12) at the C1 connector female side. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. Rotor resistance should be measured approximately 7-14 ohms. If resistance is measured proceed to Step 6. If no resistance is measured continue.
4. Remove the control panel assembly to access the brushes. See Figure 6-21. Connect one meter test lead across Wire 4 (Pin 11) at the C1 connector female side. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. Connect the other meter test lead to Wire 4 at the brush assembly. Continuity should be measured. If INFINITY is measured repair or replace Wire 4.
5. Connect one meter test lead across Wire 0 (Pin 12) at the C1 connector female side. Be careful not to damage the pin connectors with the test leads, use paper clips - do not force probes into connectors. Connect the other meter test lead to Wire 0 at the brush assembly. Continuity should be measured. If INFINITY is measured repair or replace Wire 0.
6. Unplug the six pin connector at the Voltage Regulator.
7. Locate the male side of Connector C1 located on the bottom of the control panel. See Figure 6-19. Connect one meter test lead to Pin 11 Wire 4. Connect the other meter test lead to Wire 4 at the six pin connector previously removed from the Voltage Regulator. See Figure 6-11. Be careful not to damage the pin connectors with the test leads. Continuity should be measured. If continuity is not measured repair or replace Wire 4 between the C1 connector and the six-pin Voltage Regulator connector.
8. Connect one meter test lead to Pin 12 Wire 0. See Figure 6-19. Connect the other meter test lead to the ground terminal in the control panel. Continuity should be measured. If continuity is not measured repair or replace Wire 0 between the C1 connector and the ground terminal.

RESULTS:

1. Repair or replace wiring/terminals as needed.
2. If no faults are found refer to flow chart.

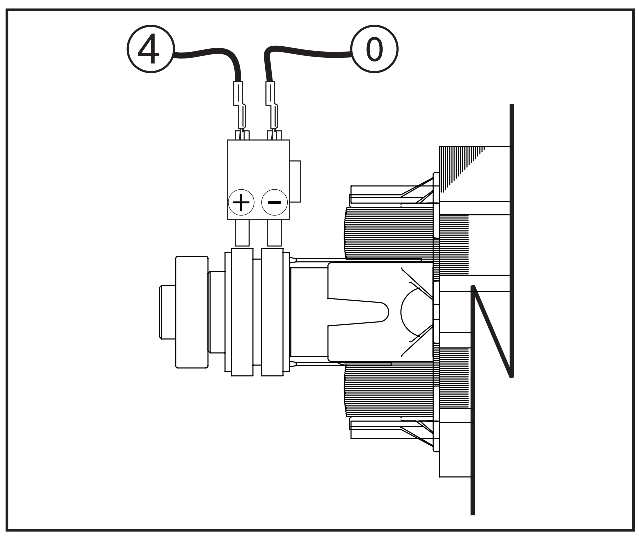



*Figure 6-20. – Brush Leads*

## TEST 13 - CHECK BRUSHES & SLIP RINGS

PROCEDURE:

1. Gain access to the brushes and slip rings.

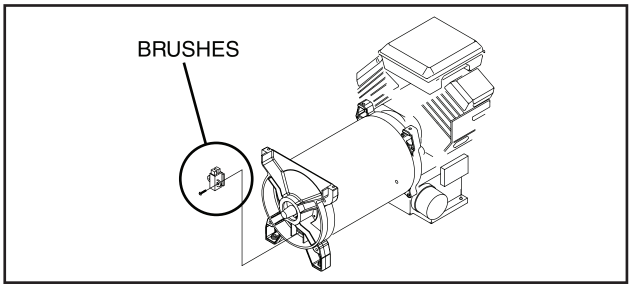



*Figure 6-21. – Brush Location*

2. Remove Wire 4 from the positive (+) brush terminal.
3. Remove the ground wire (0) from the negative (-) brush.
4. Remove the brush holder, with brushes.
5. Inspect the brushes for excessive wear, damage, cracks, chipping, etc.
6. Inspect the brush holder, replace if damaged.
7. Inspect the slip rings.
   a. If slip rings appear dull or tarnished they may be cleaned and polished with fine sandpaper. DO NOT USE ANY METALLIC GRIT TO CLEAN SLIP RINGS. (A 400 grit wet sandpaper is recommended).
   b. After cleaning slip rings, blow away any sandpaper residue.

RESULTS:

1. Replace bad brushes. Clean slip rings, if necessary.
2. If brushes and rings are good, go to Test 14.

## *TEST 14 - CHECK ROTOR ASSEMBLY*

PROCEDURE:

Gain access to the brushes and slip rings. Disconnect Wire 4 and Wire 0 from their respective brushes and remove the brush holder. Then, test the Rotor as follows:

1. Set a voltmeter to measure resistance.
2. Connect the positive (+) meter test lead to the positive (+) slip ring (nearest the Rotor bearing). Connect the common (-) test lead to the negative (-) slip ring. Read the resistance of the Rotor windings, in OHMS.

| ROTOR RESISTANCE * | |
|---|---|
| **MODEL:** | **OHMS** |
| 004451-0 004986-0 | 7.01Ω |
| 004582-0,1 004987-0 005209-0 | 7.71Ω |
| 004582-2 004987-1 | 13.1Ω |
| 004583-0 005308-0 | 14.2Ω |

* Resistance values in ohms at 20° C. (68° F.). Actual readings may vary depending on ambient temperature. A tolerance of plus or minus 5% is allowed.

3. Connect the positive (+) meter test lead to the positive (+) slip ring, the common (-) test lead to a clean frame ground (such as the Rotor shaft). The meter should read INFINITY.

RESULTS:

1. Replace the Rotor if it fails the test.
2. If Rotor checks good, perform "Rotor Insulation Resistance Test," on Page 15.

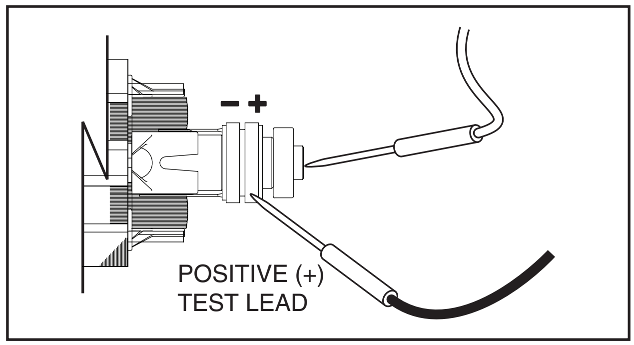



*Figure 6-22. – Testing at Slip Rings*

## *TEST 15 - CHECK LOAD VOLTAGE & FREQUENCY*

PROCEDURE:

Perform this test in the same manner as Test 1, but apply a load to the generator equal to its rated capacity. With load applied check voltage and frequency.

Frequency should not drop below about 59 Hertz with the load applied.

Voltage should not drop below about 235 VAC with load applied.

RESULTS:

1. If voltage and/or frequency drop excessively when the load is applied, go to Test 16.
2. If load voltage and frequency are within limits, end tests.

## *TEST 16 - CHECK LOAD WATTS & AMPERAGE*

PROCEDURE:

Add up the wattages or amperages of all loads powered by the generator at one time. If desired, a clamp-on ammeter may be used to measure current flow. See "Measuring Current" on Page 7.

RESULTS:

1. If the unit is overloaded, reduce the load.

2. If load is within limits, but frequency and voltage still drop excessively, refer back to Flow Chart.

## TEST 17 - CHECK BATTERY CHARGE OUTPUT

PROCEDURE:

1. Disconnect Wire 15 (center terminal) from the Battery Charge Rectifier 2 (BCR2), which is located under BCR1. They are stacked. See Page 17 for BCR2 location.

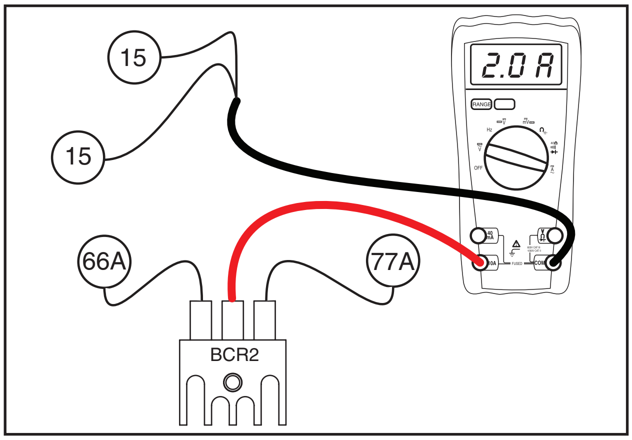



*Figure 6-23. – Testing BCR2*

2. Set a voltmeter to measure DC Amps. Connect the positive (+) test lead to the center terminal of the Battery Charge Rectifier. Connect the negative (-) test lead to Wire 15 previously disconnected.
3. Start the generator. The amp reading on the voltmeter should be approximately 0.6 Amps. Apply full load to the generator. The amp reading should increase to approximately 2 Amps.

RESULTS:

1. If amperage was measured between 0.6 to 2 Amps in Step 2 and Step 3, the charging system is working.
2. If no amperage was measured, check the voltmeter fuses and verify the functioning of the Amp Meter. If DC Amp Meter is good and no current is measured refer to flow chart.

## TEST 18 - CHECK 10 AMP BATTERY CHARGE OUTPUT

PROCEDURE:

***NOTE: The battery charge cable must be connected to the 12 VDC panel receptacle and be charging a separate battery to perform this test.***

1. Disconnect Wire 13A (center terminal) from the Battery Charge Rectifier 1 (BCR1), which is located on top of BCR2 they are stacked. See Page 17 for BCR1 location.
2. Set a voltmeter to measure DC Amperage. Connect the positive (+) test lead to the center terminal of the Battery Charge Rectifier. Connect the negative (-) test lead to Wire 13A previously disconnected. See Figure 6-24.

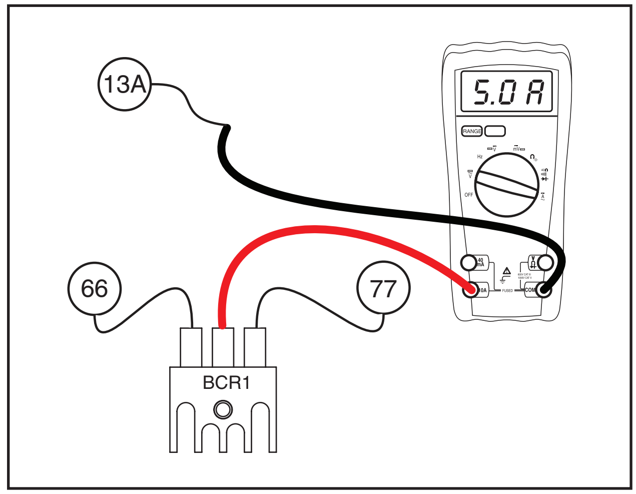



*Figure 6-24. – Testing BCR1*

3. Start the generator. The amp reading on the voltmeter should be approximately 0.2 Amps. Apply full load to the generator. The amp reading should increase. It will depend upon the state of charge of the battery as to how high current will get. Normal ranges at full load can be 3-7 amps, but can get as high as 10 amps.

RESULTS:

1. If amperage was measured between 0.2 to 10 Amps in Step 2 and Step 3, the charging system is working.
2. If no amperage was measured, check the voltmeter fuses and verify the functioning of the Amp Meter. If DC Amp Meter is good and no current is measured refer to flow chart.

## TEST 19 - CHECK BATTERY CHARGE RECTIFIER (BCR2)

PROCEDURE:

1. Disconnect all wires from the Battery Charge Rectifier.
2. Set the VOM to the Diode Test range. Connect the negative (-) test lead to the center terminal of the BCR. Connect the positive (+) test lead to an outer terminal. The meter should measure approximately 0.5 volts. Now connect the positive test lead to the other outer terminal. Again, the meter should measure approximately 0.5 volts.
3. Connect the positive (+) test lead to the center terminal of the BCR. Connect the negative (-) test lead to an outer terminal. The meter should measure INFINITY. Connect the negative test lead to the other outer terminal. INFINITY should once again be measured.

Short to Ground:

4. Set the VOM to measure resistance. Connect the positive (+) test lead to the case housing of the BCR. Connect the negative (-) test lead to an outer terminal. INFINITY should be measured. Now connect the negative test lead to the BCR center terminal. INFINITY should be measured. Next, connect the negative test lead to the remaining outer BCR terminal. Once again INFINITY should be measured.

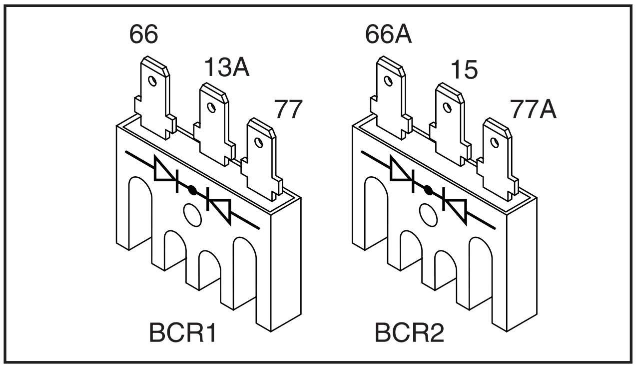



*Figure 6-25. – Battery Charge Rectifier*

RESULTS:

1. If any of the previous steps has failed, replace the Battery Charge Rectifier.
2. If the BCR tests good, refer back to the flow chart.

## TEST 20 - CHECK 10 AMP CIRCUIT BREAKER

PROCEDURE:

1. Set a voltmeter to measure resistance.
2. Locate the 10 Amp circuit breaker (CB1) in the control panel. See Page 17 for Circuit breaker location.
3. Disconnect Wire 15A and Wire 13A from the circuit breaker.
4. Connect one meter test lead to one terminal of the circuit breaker. Connect the other meter test lead to the remaining terminal on the circuit breaker. Continuity should be measured. See Figure 6-26.

RESULTS:

1. If continuity was measured the breaker is good refer back to the flow chart.
2. If INFINITY or a open condition was measured replace the circuit breaker.

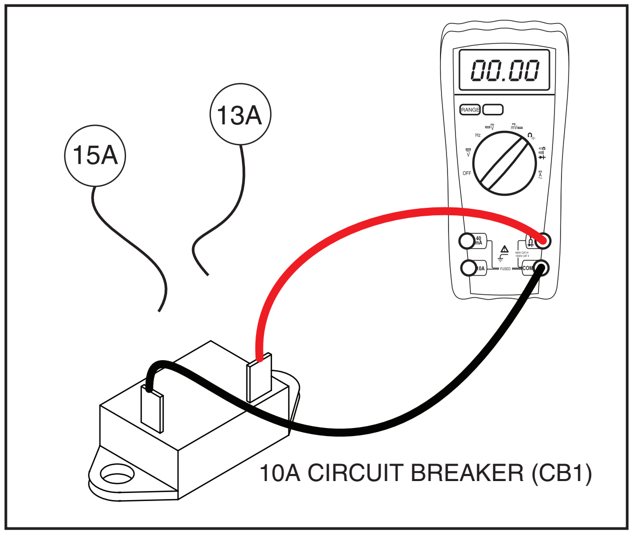



*Figure 6-26. – Testing 10 Amp Breaker*

## TEST 21- CHECK 10 AMP FUSE

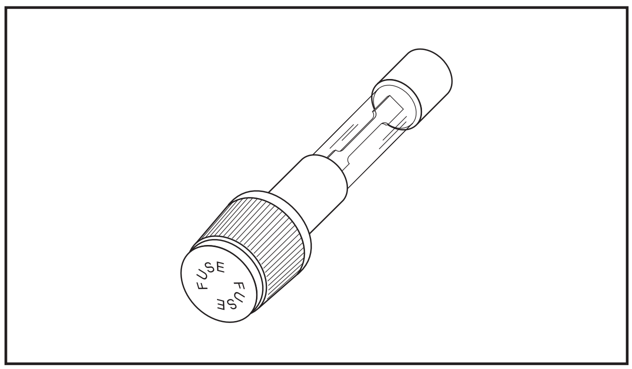



*Figure 6-27. – 10 Amp Fuse (Located in Rear of Control Panel)*

PROCEDURE:

Push in on fuse holder cap and turn counterclockwise. Then, remove the cap with fuse. Inspect the Fuse.

RESULTS:

If the Fuse element has melted open, replace the Fuse with an identical size fuse. If Fuse is good, refer back to flow chart.

## TEST 22- CHECK BATTERY & CABLES

PROCEDURE:

1. Inspect the battery cables and battery posts or terminals for corrosion or tightness. Measure the voltage at the terminal of the Starter Contactor and verify 11-12 volts DC is available to the generator during cranking. If voltage is below 11 volts DC,

measure at the battery terminals during cranking. If battery voltage is below 11 volts DC, recharge/replace battery. If battery or cables are still suspected, connect an alternate battery and cables to the generator and retest.

2. Use a battery hydrometer to test the battery for (a) state of charge and (b) condition. Follow the hydrometer manufacturer's instructions carefully.

RESULTS:

1. Clean battery posts and cables as necessary. Make sure battery cables are tight.
2. Recharge the battery, if necessary.
3. Replace the battery, if necessary.
4. If battery is good, but engine will not crank, refer back to Flow Charts.

### TEST 23 - CHECK VOLTAGE AT STARTER CONTACTOR (SC)

PROCEDURE:

1. Set voltmeter to measure DC voltage.
2. Disconnect Wire 16 from the Starter Contactor located on the Starter motor.
3. Connect the positive meter test lead to Wire 16 previously removed. Connect the negative meter test lead to frame Ground.
4. Place the Start-Run-Stop Switch to Start. 12 VDC should be measured.
5. Reconnect Wire 16 to the Starter Motor.

RESULTS:

Refer back to flow chart.

### TEST 24 - CHECK STARTER CONTACTOR (SC)

PROCEDURE:

1. Carefully inspect the starter motor cable that runs from the Battery to the Starter Motor. Cable connections should be clean and tight. If connections are dirty or corroded, remove cable and clean cable terminals and studs. Replace any cable that is defective or badly corroded. Set the voltmeter to measure DC voltage. Connect the positive (+) meter test lead to the Starter Contactor stud that the battery cable is connected to. Connect the negative (-) meter test lead to a clean frame ground. Battery voltage should be measured (see Figure 6-28, **STEP 1 TEST POINT**).

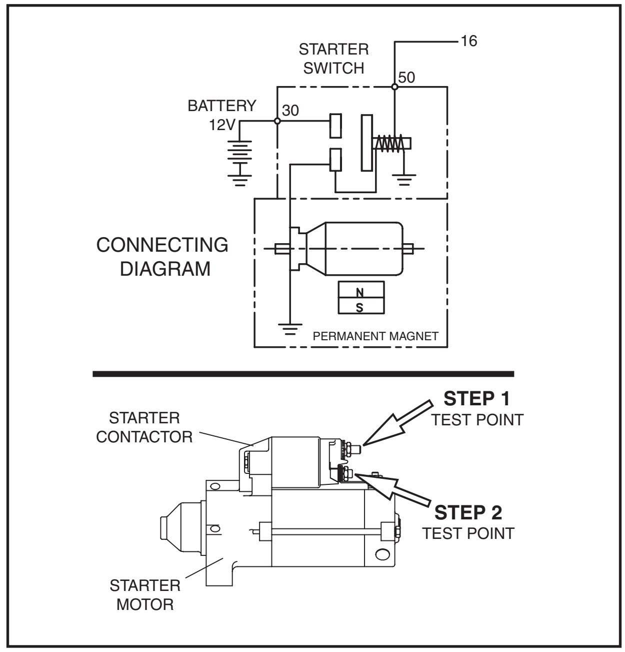



*Figure 6-28. – The Starter Contactor (SC)*

2. Set the voltmeter to measure DC voltage. Connect the positive (+) meter test lead to the Starter Contactor stud that has the small jumper wire connected to the Starter. Connect the negative (-) meter test lead to a clean frame ground. Set the Start-Stop Switch to START. Battery voltage should be measured (see Figure 6-28, **STEP 2 TEST POINT**).

RESULTS:

1. If battery voltage was not measured in Step 1, repeat Test 22.
2 If battery voltage was measured in Step 1, but not in Step 2, replace the Starter Contactor.
4. If battery voltage was measured in Step 2 but the engine still does not crank, refer back to the Flow Chart.

### TEST 25 - CHECK STARTER MOTOR

CONDITIONS AFFECTING STARTER MOTOR PERFORMANCE:

1. A binding or seizing condition in the Starter Motor bearings.
2. A shorted, open or grounded armature.
   a. Shorted, armature (wire insulation worn and wires touching one another). Will be indicated by low or no RPM.
   b. Open armature (wire broken) will be indicated by low or no RPM and excessive current draw.
   c. Grounded armature (wire insulation worn and wire touching armature lamination or shaft). Will be indicated by excessive current draw or no RPM.

3. A defective Starter Motor switch.
4. Broken, damaged or weak magnets.
5. Starter drive dirty or binding.

PROCEDURE:

The battery should have been checked prior to this test and should be fully charged.

Set a voltmeter to measure DC voltage (12 VDC). Connect the meter positive (+) test lead to the Starter Contactor stud which has the small jumper wire connected to the Starter. Connect the common (-) test lead to the Starter Motor frame.

Set the Start-Stop Switch to its START position and observe the meter. Meter should Indicate battery voltage, Starter Motor should operate and engine should crank.

RESULTS:

1. If battery voltage is indicated on the meter but Starter Motor did not operate, remove and bench test the Starter Motor (see following test).
2. If battery voltage was indicated and the Starter Motor tried to engage (pinion engaged), but engine did not crank, check for mechanical binding of the engine or rotor.

***NOTE: If a starting problem is encountered, the engine itself should be thoroughly checked to eliminate it as the cause of starting difficulty. It is a good practice to check the engine for freedom of rotation by removing the spark plugs and turning the crankshaft over slowly by hand, to be sure it rotates freely.***

**WARNING!: DO NOT ROTATE ENGINE WITH ELECTRIC STARTER WITH SPARK PLUGS REMOVED. ARCING AT THE SPARK PLUG ENDS MAY IGNITE THE GASOLINE VAPOR EXITING THE SPARK PLUG HOLE.**

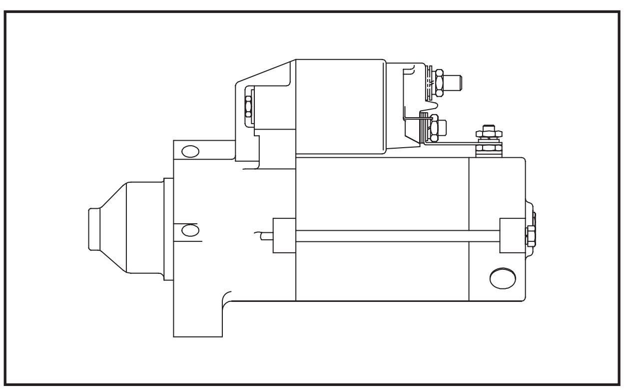


*Figure 6-29. – Starter Motor (SM)*

CHECKING THE PINION:

When the Starter Motor is activated, the pinion gear should move and engage the flywheel ring gear. If the pinion does not move normally, inspect the pinion for binding or sticking.

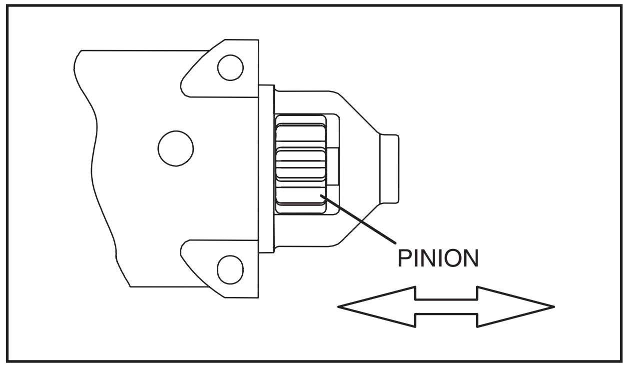



*Figure 6-30. – Check Pinion Gear Operation*

TOOLS FOR STARTER PERFORMANCE TEST:

The following equipment may be used to complete a performance test of the Starter Motor:

- A clamp-on ammeter.
- A tachometer capable of reading up to 10,000 rpm.
- A fully charged 12 volt battery.

MEASURING CURRENT:

To read the current flow, in AMPERES, a clamp-on ammeter may be used. This type of meter indicates current flow through a conductor by measuring the strength of the magnetic field around that conductor.

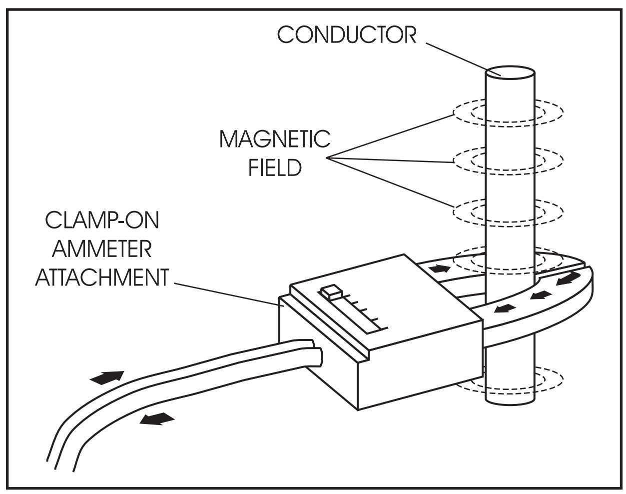



*Figure 6-31. – Clamp-On Ammeter*

TACHOMETER:

A tachometer is available from your Generac Power Systems source of supply. Order as P/N 042223. The tachometer measures from 800 to 50,000 RPM (see Figure 6-32).

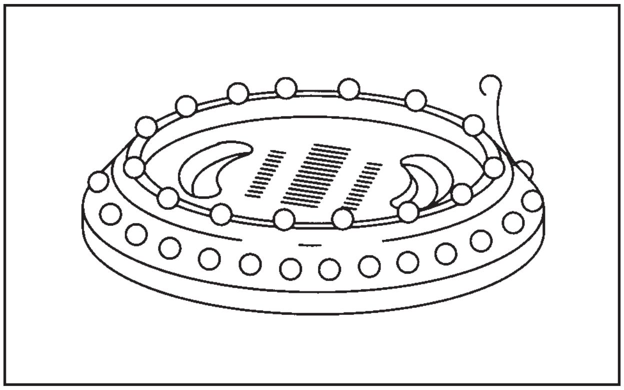


*Figure 6-32. – Tachometer*

TEST BRACKET:

A starter motor test bracket may be made as shown in Figure 6-33.

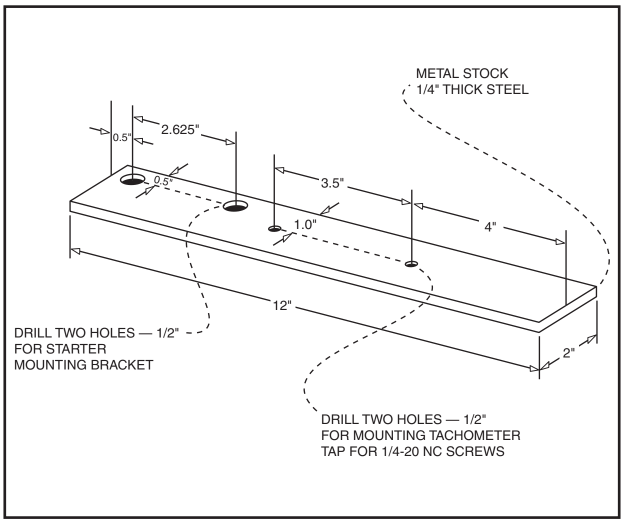



*Figure 6-33. – Test Bracket Dimensions*

REMOVE STARTER MOTOR:

It is recommended that the Starter Motor be removed from the engine when testing Starter Motor performance. Assemble starter to test bracket and clamp test bracket in vise (Figure 6-34).

TESTING STARTER MOTOR:

1. A fully charged 12 volt battery is required.
2. Connect jumper cables and clamp-on ammeter as shown in Figure 6-34.
3. With the Starter Motor activated (jump the terminal on the Starter Contactor to battery voltage), note the reading on the clamp-on ammeter and on the tachometer (rpm).

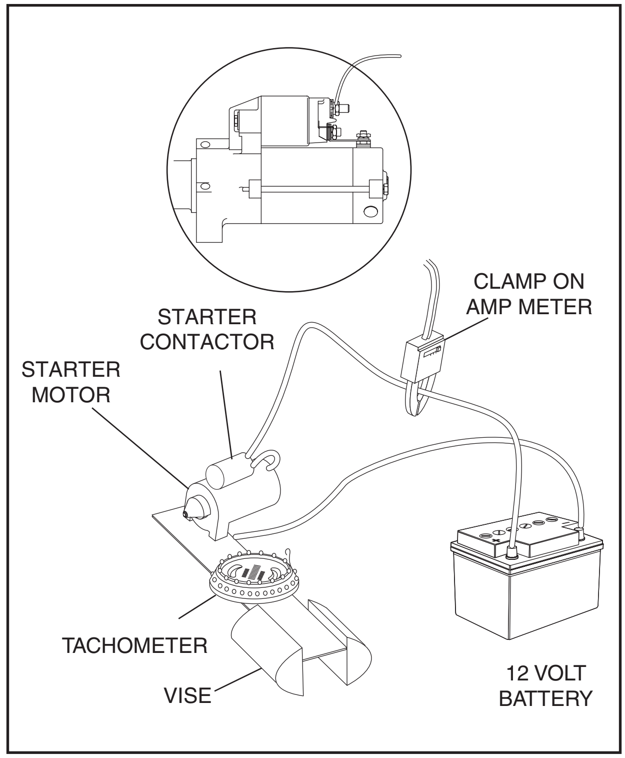



*Figure 6-34 – Testing Starter Motor Performance*

***Note: Take the reading after the ammeter and tachometer are stabilized, approximately 2-4 seconds.***

4. A starter motor in good condition will be within the following specifications:

| | |
|---|---|
| **Minimum rpm** | **4500** |
| **Maximum Amps** | **50** |

***Note: Nominal amp draw of starter in generator is 60 amps.***

## *TEST 26 - TEST STARTER CONTACTOR RELAY (SCR)*

PROCEDURE:

1. Set voltmeter to measure DC voltage.
2. Remove Wire 15 from the Starter Contactor Relay (SCR). Connect the positive meter test lead to Wire 15 previously removed. Connect the negative meter test lead to frame Ground. 12 VDC should be measured. Reconnect Wire 15 to the SCR. If 12 VDC is NOT measured on Wire 15 Stop Testing and repair or replace Wire 15 between the Fuse (F1) and the SCR.
3. Remove Wire 13 from the Starter Contactor Relay (SCR). Connect the positive meter test lead to Wire 13 previously removed. Connect the negative meter test lead to frame

Ground. 12 VDC should be measured. Reconnect Wire 13 to the SCR. If 12 VDC is NOT measured on Wire 13 Stop Testing and repair or replace Wire 13 between the Starter Contactor (SC) and the Starter Contactor Relay (SCR).

***Note: Jumper leads may be used if necessary.***

4. Set voltmeter to measure resistance.
5. Remove Wire 13, Wire 16, and Wire 17 from the Starter Contactor Relay (SCR)
6. Connect the meter leads across Terminal 87 and Terminal 30 of the SCR. See Figure 6-35.

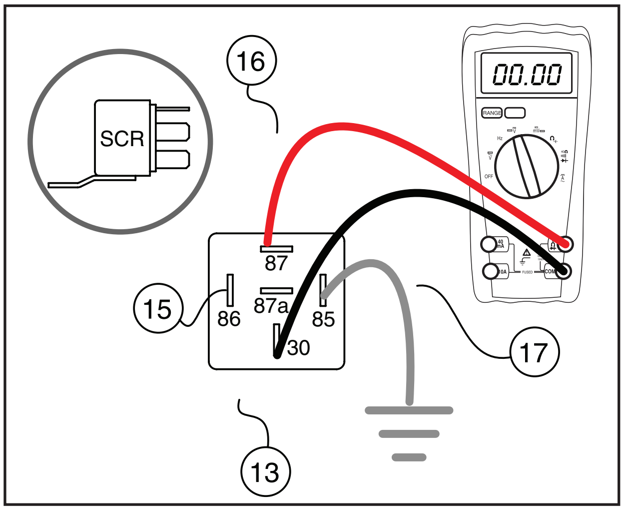



*Figure 6-35. – Starter Contactor Relay Test*

7. Connect a jumper wire from Terminal 85 to ground. The relay should energize and the voltmeter should read continuity. See Figure 6-35.
8. Reconnect all Wires.

RESULTS:

If continuity was not measured in Step 7 replace the Starter Contactor Relay. If all steps passed refer back to flow chart.

## TEST 27 - CHECK START-RUN-STOP SWITCH (SW1)

PROCEDURE:

1. Set a voltmeter to measure resistance.
2. Remove all wires from the Start-Run-Stop Switch (SW1).
3. Using the chart below ohm out the Start-Run-Stop Switch. Connect one meter test lead to one terminal and the other meter test lead to the other terminal. With meter leads connected activate the switch to Start, Stop or Run and follow the chart.
4. Reconnect all wires to the switch.

| CONDITION | TERMINALS | RESULT |
|---|---|---|
| STOP | 5,4 | OPEN |
| STOP | 5,6 | CLOSED |
| STOP | 2,1 | OPEN |
| STOP | 2,3 | CLOSED |
| RUN | ALL CONDITIONS | OPEN |
| START | 5,4 | CLOSED |
| START | 5,6 | OPEN |
| START | 2,1 | CLOSED |
| START | 2,3 | OPEN |

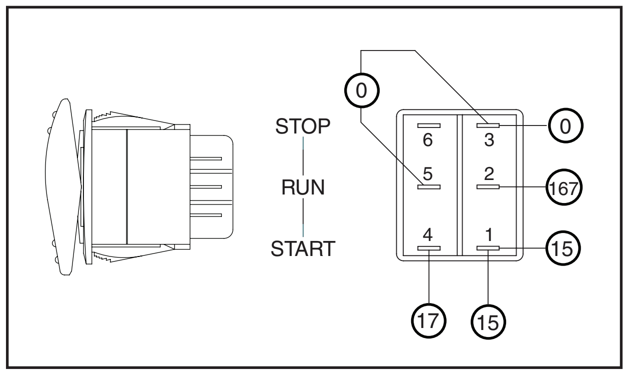



*Figure 6-36. – Start-Run-Stop Switch (SW1)*

RESULTS:

If the switch fails any part of the test procedure replace the switch.

## TEST 28 - CHECK START-RUN-STOP SWITCH (SW1) WIRING

PROCEDURE:

1. Set voltmeter to measure resistance.
2. Remove Wire 17 from the Starter Contactor Relay (SCR). Connect one meter test lead to Wire 17. Remove Wire 17 from the Start-Run-Stop Switch (SW1). Connect the other meter test lead to wire 17. Continuity should be measured.
3. Remove both Wire 0 from the Start-Run-Stop switch (SW1) it is located in two positions on the switch. Connect one meter test lead to one Wire 0 and connect the other meter test lead to the other Wire 0. Continuity should be measured.
4. Remove Wire 0 from the Start-Run-Stop switch (SW1) it is located in two positions on the switch. Connect one meter test lead to one Wire 0 and connect the other meter test lead to frame ground. Continuity should be measured.

5. Set voltmeter to measure DC voltage.
6. Remove Wire 15 from the Start-Run-Stop Switch (SW1). Connect the positive meter test lead to Wire 15. Connect the negative meter test lead to frame ground. 12 VDC should be measured.

RESULTS:

Repair or replace any wiring that did not have continuity.

If voltage was not measured in Step 6 repair wiring between the Starter Contactor Relay (SCR) and the Start-Run-Stop Switch (SW1).

If all steps passed repair or replace Wire 16 between the Starter Contactor (SC) and the Starter contactor Relay (SCR).

## *TEST 29 - CHECK IGNITION SPARK*

PROCEDURE:

A commercially available spark tester may be used to test the engine ignition system. One can also be purchased from Generac Power Systems (Part No. 0C5969).

1. Disconnect a high tension lead from a spark plug.
2. Attach the high tension lead to the spark tester terminal.
3. Ground the spark tester clamp by attaching to the cylinder head (see Figure 6-37).
4. Crank the engine rapidly. Engine must be cranking at 350 rpm or more. If spark jumps the tester gap, you may assume the ignition system is working properly. Repeat on remaining cylinder spark plug.
5. If spark jumps the tester gap intermittently, the problem may be in the Ignition Magneto.

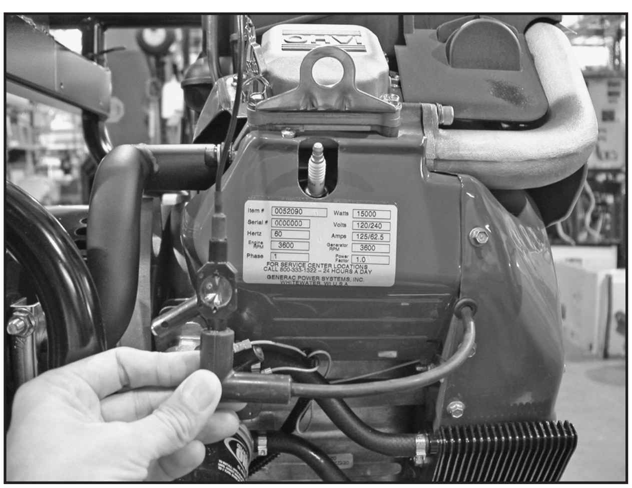


*Figure 6-37. – Testing Ignition System*

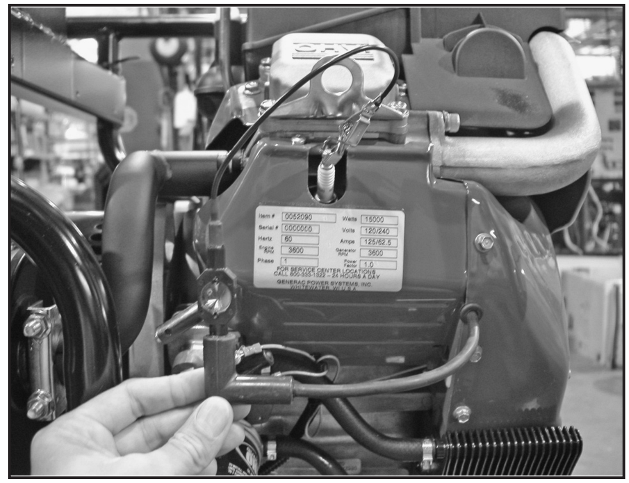


*Figure 6-38. – Checking Engine Miss*

RESULTS:

Refer back to the Flow Chart

## *TEST 30 - CHECK SPARK PLUGS*

PROCEDURE:

Remove spark plugs. Clean with a commercial solvent. DO NOT BLAST CLEAN SPARK PLUGS. Replace spark plugs if badly fouled, if ceramic is cracked, or if badly worn or damaged. Set gap to 0.040 inch (1.016 mm). Use a Champion RC14YC (or equivalent) replacement spark plug.

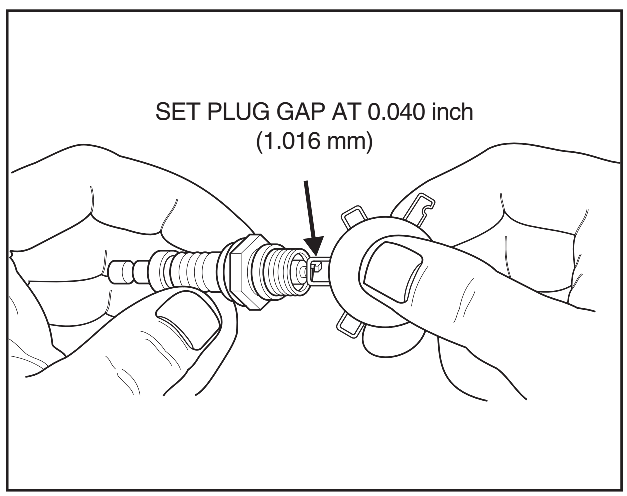



*Figure 6-39. – Setting Spark Plug Gap*

RESULTS:

1. Clean and regap or replace sparks plug as necessary.
2. Refer back to the Flow Chart.

### *TEST 31 - REMOVE WIRE 18 / SHUTDOWN LEAD*

PROCEDURE:

1. Disconnect Wire 18 from the Stud located above the oil cooler that extends out From the shrouding.
2. Perform Test 29 again checking for Spark.

RESULTS:

Refer back to Flow Chart.

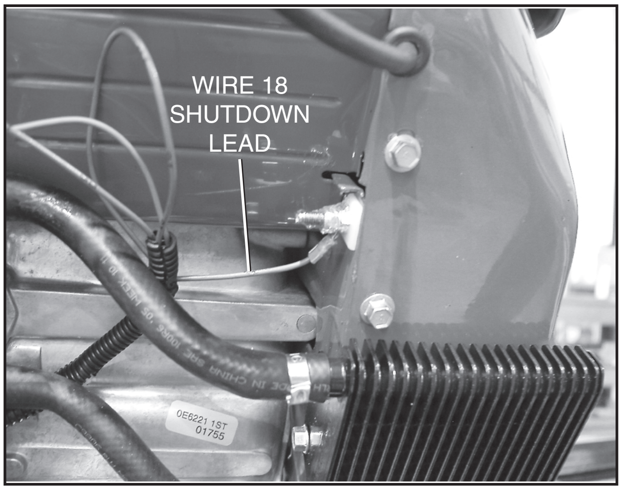



*Figure 6-40. – Wire 18*

### *TEST 32 - TEST START STOP RELAY (SSR)*

PROCEDURE:

1. Set a voltmeter to measure DC voltage.
2. Remove Wire 15 from Terminal 13 on the Start Stop Relay (SSR). Connect the positive meter test lead to Wire 15 previously removed. Connect the negative meter test lead to frame ground. 12 VDC should be measured, if it is proceed to Step 3. If 12 VDC is not measured repair or replace Wire 15 between the SSR and the Battery Charge Rectifier 2 (BCR2).
3. With Wire 15 reconnected to the SSR remove Wire 229 from the SSR. Connect a jumper lead from the terminal of the SSR that Wire 229 was just removed from and to frame ground. See Figure 6-43. The relay should energize closed, visually inspect it to see if it closes. If the relay energizes closed proceed to Step 4. If the relay does not energize closed replace it.
4. Remove Wire 0, Wire 18, Wire 15, Wire 15B, Wire 15, and Wire 14. See Figure 6-42.
5. Set a voltmeter to measure resistance. Remove jumper lead from Step 3. Connect meter test leads across TEST POINTS A continuity/closed should be measured. Connect meter test leads across TEST POINTS B INFINITY should be measured. Connect meter test leads across TEST POINTS C. INFINITY should be measured (See Figure 6-42). If the SSR fails any test replace it.
6. Remove Wire 229 from the SSR. Connect a jumper lead from the terminal of the SSR that Wire 229 was just removed from and to frame ground. The relay should energize closed. Set a voltmeter to measure resistance. Connect meter test leads across TEST POINTS A INFINITY should be measured. Connect meter test leads across TEST POINTS B continuity/closed should be measured. Connect meter test leads across TEST POINTS C continuity/closed should be measured. See Figure 6.43. If the SSR fails any test replace it.

RESULTS:

Refer to Flow Chart.

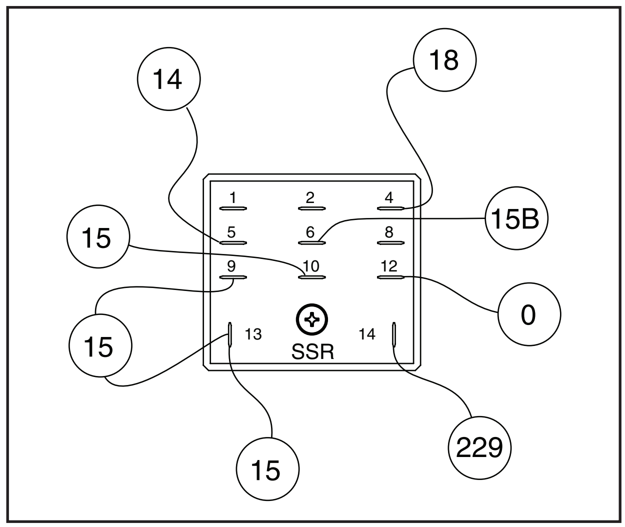



*Figure 6-41. – Start Stop Relay (SSR)*

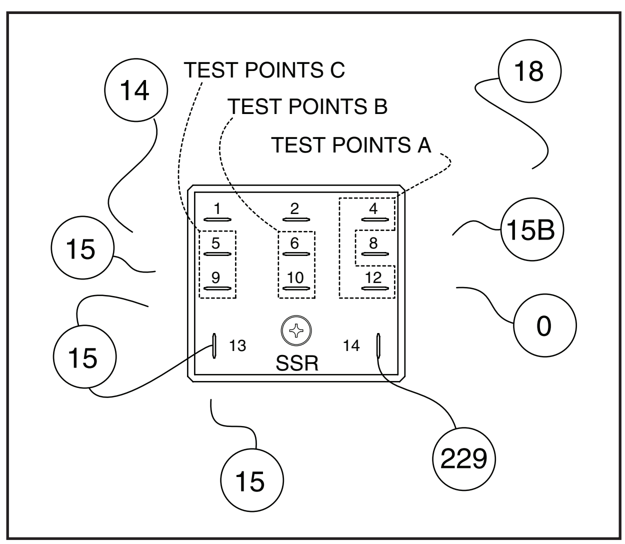



*Figure 6-42. – Start Stop Relay (SSR) Not Energized*

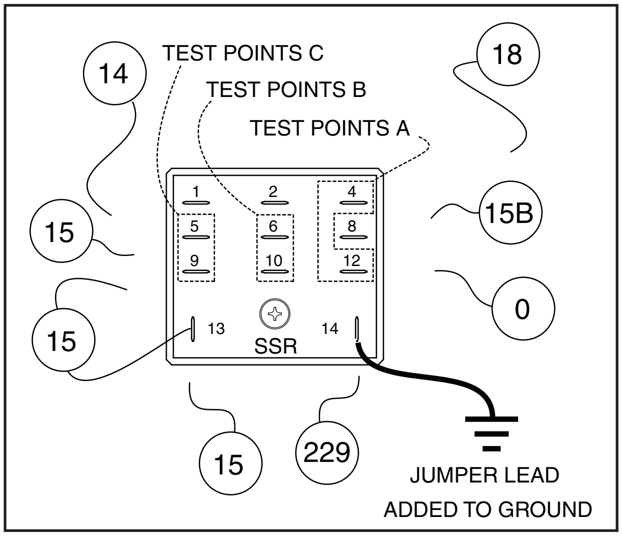



*Figure 6-43. – Start Stop Relay (SSR) Energized*

## *TEST 33 - TEST WIRE 167*

PROCEDURE:

1. Set a voltmeter to measure DC voltage.
2. Remove the J2 connector from the circuit board. Connect the positive meter test lead to Pin Location J2-5, Wire 167 on the removed harness connector. See Figure 6-44 Connect the negative meter test lead to frame ground. Place the Start-Run-Stop switch (SW1) to start. The engine will crank and 12 VDC should be measured. If 12 VDC is measured, stop testing. If 12 VDC is not measured continue testing.

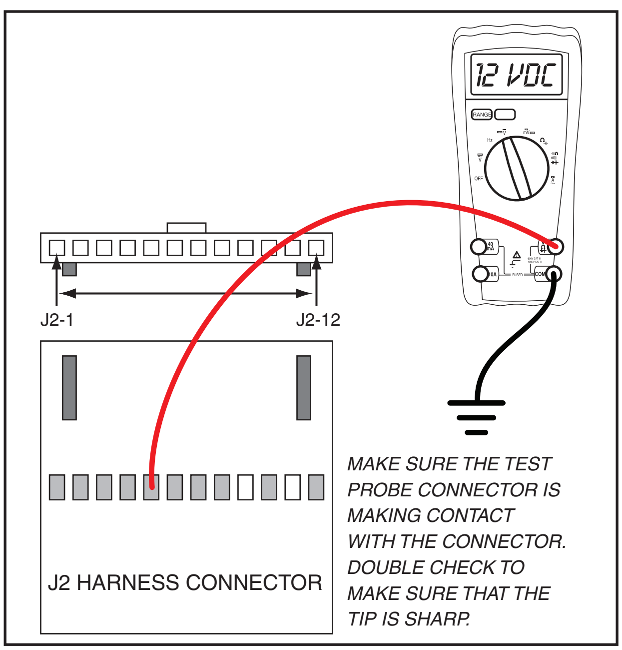



*Figure 6-44. – Test Wire 167, Step 2*

3. Connect the positive test lead to Wire 167 at Terminal Block 1 (TB1). Connect the negative meter test lead to frame ground. Place the Start-Run-Stop Switch (SW1) to start. 12 VDC should be measured. If 12 VDC is measured, replace Wire 167 between TB1 and the J2 connector. If 12 VDC is not measured continue testing.

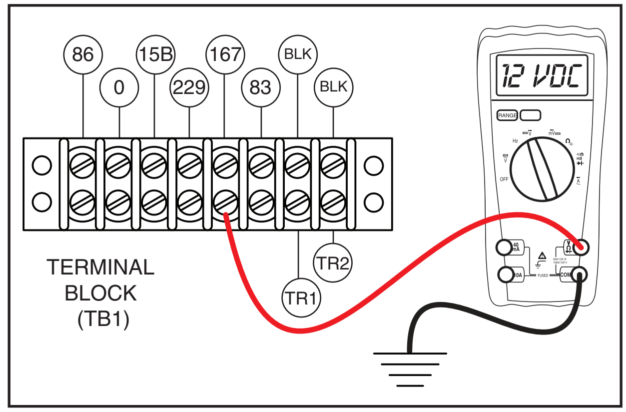



*Figure 6-45. – Test Wire 167, Step 3*

4. Connect the positive test lead to Wire 167 with it connected at the Start Run Stop Switch (SW1). Connect the negative meter test lead to frame ground. Place the Start-Run-Stop Switch (SW1) to start. 12 VDC should be measured. If 12 VDC is measured, repair or replace Wire 167 between SW1 and the TB1. If 12 VDC is not measured continue testing.

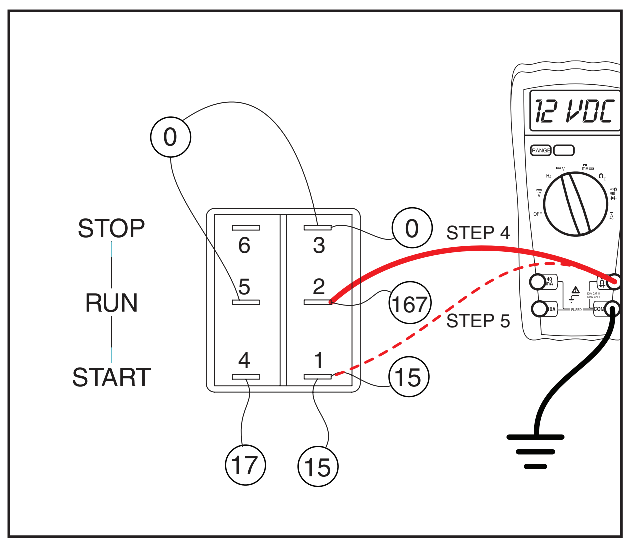



*Figure 6-46. – Test Wire 167, Steps 4 & 5*

5. Connect the positive meter test to Wire 15 at SW1. See Figure 6-46. Connect the negative meter test lead to frame ground. 12 VDC should be measured. If 12 VDC is measured, replace SW1. If 12 VDC is not measured repair or replace wire 15 between SW1 and the Starter Contactor Relay (SCR).

## TEST 34 - TEST START STOP RELAY WIRING

PROCEDURE:

1. Set voltmeter to the diode test range.
2. Disconnect Wire 229 from the Start Stop Relay (SSR).
3. Connect the positive meter test lead to Wire 229 previously removed. Connect the negative meter test lead to frame ground. See Figure 6-47. Place the Start-Run-Stop Switch to the start position. The meter should read approximately 1.0 VDC. If the correct voltage is indicated, stop testing.

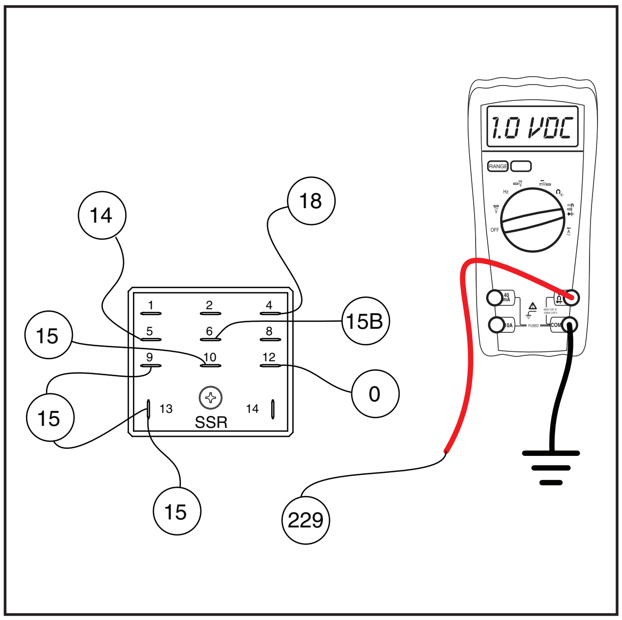



Figure 6-47. – Testing Wire 229 to Ground

4. Set voltmeter to measure resistance.
5. If voltage was not measured in Step 3 connect one meter test lead to Wire 229 removed from the SSR. Connect the other meter test lead to Wire 229 at the Terminal Block 1 (TB1). Continuity should be measured. If continuity is not measured repair or replace Wire 229 between SSR and TB1. Remove the J2 connector the printed circuit board. Connect one meter test lead to pin location J2-8 (Wire 229) connect the other meter test lead to Wire 229 at TB1. See Figure 6-48. Be careful not to damage the pin connectors with the test leads. Continuity should be measured. If continuity is not measured repair or replace Wire 229 between the J2 connector and TB1.

RESULTS:

1. If Step 3 passed refer to Flow Chart.
2. If Step 3 failed and Step 5 passed replace the printed circuit board.

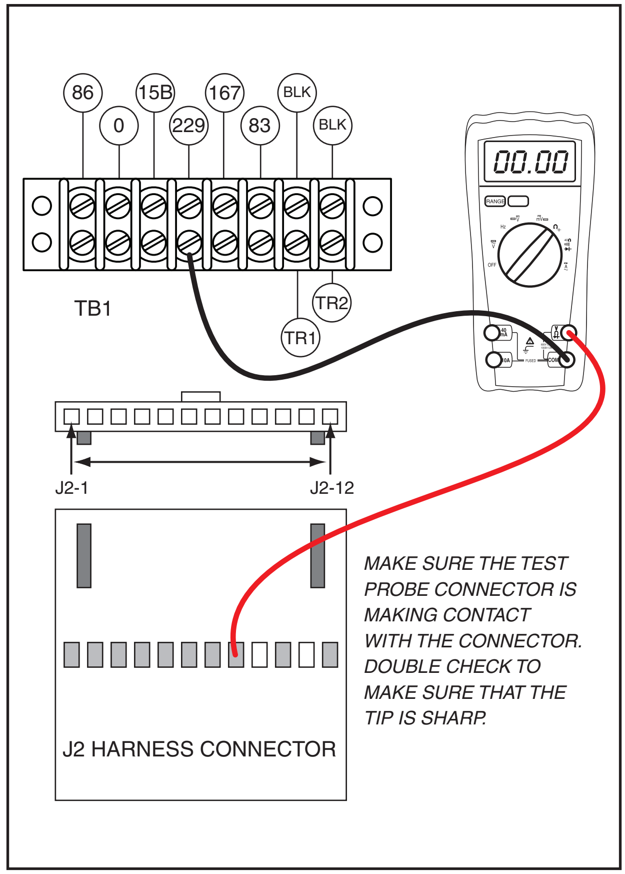



Figure 6-48. – Testing Wire 229 Between J2 Connector and Terminal Block 1 (TB1)

## TEST 35 - CHECK AND ADJUST IGNITION MAGNETOS

PROCEDURE:

1. See Figure 6-49. Rotate the flywheel until the magnet is under the module (armature) laminations.
2. Place a 0.008-0.012 inch (0.20-0.30mm) thickness gauge between the flywheel magnet and the module laminations.
3. Loosen the mounting screws and let the magnet pull the magneto down against the thickness gauge.
4. Tighten both mounting screws.
5. To remove the thickness gauge, rotate the flywheel.
6. Repeat the above procedure for the second magneto.
7. Repeat Test 29 and check for spark across the spark tester gap.
8. If air gap was not out of adjustment, remove engine ground harness from magnetos. Repeat Test 29. If sparking now occurs replace engine ground harness.

9. Now check the flywheel magnet by holding a screwdriver at the extreme end of its handle and with its point down. When the tip of the screwdriver is moved to within 3/4 inch (19mm) of the magnet, the blade should be pulled in against the magnet.
10. Now check the flywheel key. The flywheel's taper is locked on the crankshaft taper by the torque of the flywheel nut. A keyway is provided for alignment only and theoretically carries no load.

***Note: If the flywheel key becomes sheared or even partially sheared, ignition timing can change. Incorrect timing can result in hard starting or failure to start.***

RESULTS:

If sparking still does not occur after adjusting the armature air gap, testing the ground wires and performing the basic flywheel test, replace the ignition magneto(s).

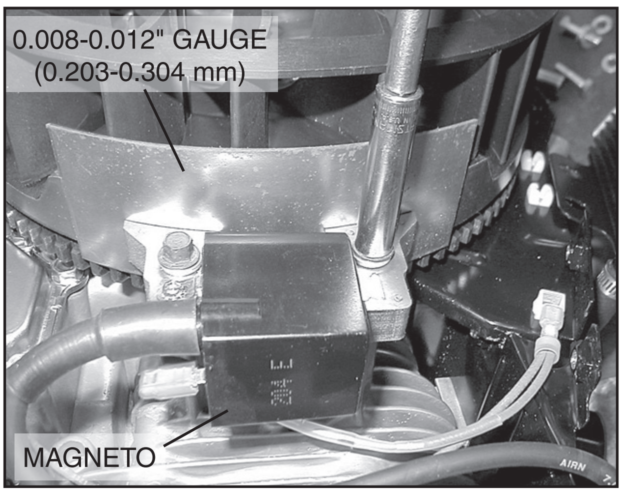



*Figure 6-49. – Setting Ignition Magneto (Armature) Air Gap*

## TEST 36 - TEST FUEL SHUTOFF SOLENOID (FSS)

PROCEDURE

1. Disconnect Wire 16 from the Starter Contactor (SC) located on the starter motor.
2. Remove the air cleaner cover.
3. Place the Start-Run-Stop Switch (SW1) to STOP then to START. When SW1 is activated a click should be heard and or activation of the Fuel Shutoff Solenoid should be felt. It can then be assumed that the Fuel Shutoff Solenoid is functioning.

RESULTS:

Refer to flow chart.

## TEST 37: TEST FUEL SHUTOFF SOLENOID VOLTAGE

PROCEDURE:

1. Set a voltmeter to measure DC voltage.
2. Disconnect the two pin connector from the Fuel Shutoff Solenoid (FSS).
3. Connect the positive meter test lead to the red wire. Connect the negative meter test lead to the black wire. Place the Start-Run-Stop switch (SW1) to START. During cranking, 12 VDC should be measured. If DC voltage is not measured continue testing.
4. Set a voltmeter to measure resistance.
5. Connect one meter test lead to the black wire. Connect the other meter test lead to frame ground. Continuity should be measured. If continuity is not measured repair or replace the black ground wire or correct poor ground connection.
6. Set a voltmeter to measure DC voltage.
7. Remove Wire 14 from the Start-Stop Relay (SSR). Refer to Figure 6-41 on Page 54. Connect the positive meter test lead to the terminal of the SSR that Wire 14 was just removed. Connect the negative meter test lead to frame ground. Place the Start-Run-Stop Switch (SW1) to the start position. 12 VDC should be measured. If 12 VDC is measured repair or replace Wire 14 between the SSR and Resistor 1 or between Resistor 1 and the FSS.

RESULTS:

Refer to flow chart.

## TEST 38 - CHECK FUEL PUMP

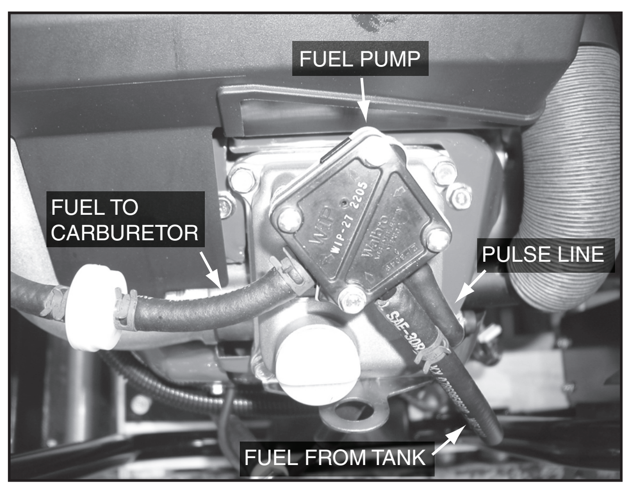



*Figure 6-50. – Fuel Pump and Fuel Lines*

PROCEDURE:

1. Remove the fuel line from the fuel filter on the inlet side of the carburetor. Use a suitable catch can to catch fuel.
2. Crank the engine over, fuel should flow from the fuel line. If fuel does not flow, verify that fuel is available to the pump. If fuel is available to the pump inspect the fuel filter, pulse line, and or replace the fuel pump.

RESULTS:

Refer to flow chart.

### *TEST 39 - CHECK CARBURETION*

PROCEDURE:

Before making a carburetion check, be sure the fuel supply tank has an ample supply of fresh, clean gasoline.

Check that all shutoff valves are open and fuel flows freely through the fuel line.

Make sure the choke operates properly.

If the engine will not start, remove and inspect the spark plug. If the spark plug is wet, look for the following:

- Overchoking.
- Excessively rich fuel mixture.
- Water in fuel.
- Intake valve stuck open.
- Needle/float stuck open.

If the spark plug is dry look for the following:

- Leaking carburetor mounting gaskets.
- Intake valve stuck closed.
- Inoperative fuel pump.
- Plugged fuel filter(s).
- Varnished carburetor

If the engine starts hard or will not start, look for the following:

- Physical damage to the AC generator. Check the Rotor for contact with the Stator.
- Starting under load. Make sure all loads are disconnected or turned off before attempting to crank and start the engine.
- Check that the choke is working properly.

1. Remove fuel line at carburetor and ensure that there is an adequate amount of fuel entering the carburetor.
2. Remove the float bowl and check to see if there is any foreign matter in bottom of carburetor bowl.
3. The float is plastic and can be removed for access to the needle so it can be cleaned.
4. With all of this removed carburetor cleaner can be used to clean the rest of the carburetor before reassembly.
5. After cleaning carburetor with an approved carburetor cleaner, blow dry with compressed air and reassemble.

Shelf life on gasoline is 30 days. Proper procedures need to be taken for carburetors so that the fuel doesn't varnish over time. A fuel stabilizer must be used at all times in order to ensure that the fuel is fresh at all times.

RESULTS:

If carburetor is varnished, clean or replace. Refer to Flow Chart.

### *TEST 40 - VALVE ADJUSTMENT*

ADJUSTING VALVE CLEARANCE:

The valve lash must be adjusted correctly in order to provide the proper air/fuel mixture to the combustion chamber.

Adjust valve clearance with the engine at room temperature. The piston should be at top dead center (TDC) of its compression stroke (both valves closed).

An alternative method is to turn the engine over and position the intake valve fully open (intake valve spring compressed) and adjust the exhaust valve clearance. Turn the engine over and position the exhaust valve fully open (exhaust valve spring compressed) and adjust the intake valve clearance.

Correct valve clearance is given below.

| | |
|---|---|
| **Intake Valve** | **0.002-0.004 inch (0.05-0.1 mm)** |
| **Exhaust Valve** | **0.002-0.004 inch (0.05-0.1 mm)** |

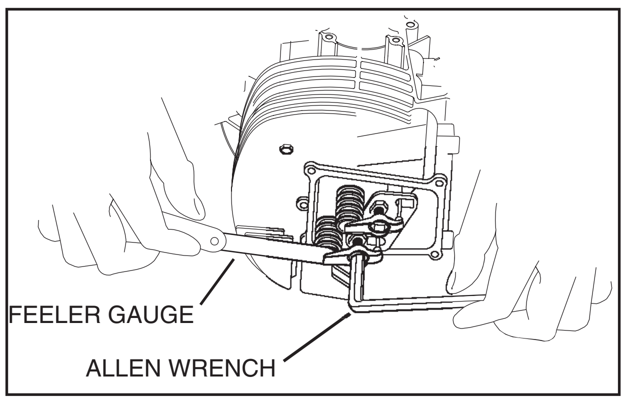



*Figure 6-51. – Adjusting Valve Clearance*

1. Loosen the rocker arm jam nut. Use a 10mm allen wrench to turn the pivot ball stud while checking the clearance between the rocker arm and valve stem with a feeler gauge (see Figure 6-51).
2. When clearance is correct, hold the pivot ball stud with the allen wrench and tighten the rocker arm jam nut to the specified torque with a crow's foot. After tightening the jam nut, recheck valve clearance to make sure it did not change.

**TORQUE SPECIFICATION**
**ROCKER ARM JAM NUT**
**168 inch-pounds (19 Nm)**

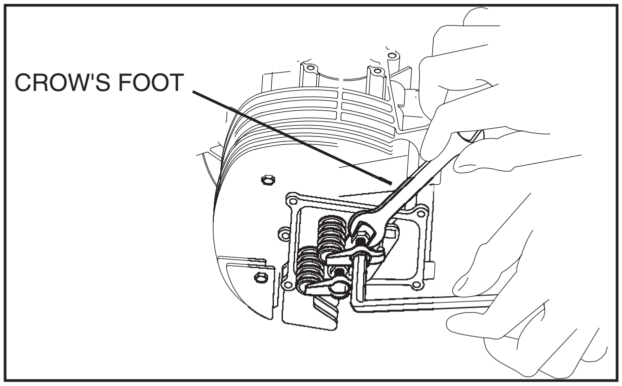



*Figure 6-52 – Tightening the Jam Nut*

INSTALL ROCKER ARM COVER

1. Use a new rocker arm cover gasket. Install the rocker arm cover and retain with four screws.

RESULTS:

Adjust valves to specification and retest. If problem continues, refer to Flow Chart.

## *TEST 41 - CHECK ENGINE / CYLINDER LEAK DOWN TEST / COMPRESSION TEST*

Most engine problems may be classified as one or a combination of the following:

- Will not start.
- Starts hard.
- Lack of power.
- Runs rough.
- Vibration.
- Overheating.
- High oil consumption.

The Cylinder Leak Down Tester (Generac P/N 0F77000SRV) checks the sealing (compression) ability of the engine by measuring air leakage from the combustion chamber. Compression loss can present many different symptoms. This test is designed to detect the section of the engine where the fault lies before disassembling the engine.

PROCEDURE:

1. Remove a spark plug.
2. Gain access to the flywheel. Remove the valve cover.
3. Rotate the engine crankshaft until the piston reaches top dead center (TDC). Both valves should be closed.
4. Lock the flywheel at top dead center.
5. Attach cylinder leak down tester adapter to spark plug hole.
6. Connect an air source of at least 90 psi to the leak down tester.
7. Adjust the regulated pressure on the gauge to 80 psi.
8. Read the right hand gauge on the tester for cylinder pressure. 20 percent leakage is normally acceptable. Use good judgement, and listen for air escaping at the carburetor, the exhaust, and the crankcase breather. This will determine where the fault lies.
9. Repeat Steps 1 through 8 on remaining cylinder.

RESULTS:

- Air escapes at the carburetor – check intake valve.
- Air escapes through the exhaust – check exhaust valve.
- Air escapes through the breather – check piston rings.
- Air escapes from the cylinder head – the head gasket should be replaced.

CHECK COMPRESSION:

Lost or reduced engine compression can result in (a) failure of the engine to start, or (b) rough operation. One or more of the following will usually cause loss of compression:

- Blown or leaking cylinder head gasket.
- Improperly seated or sticking-valves.
- Worn Piston rings or cylinder. (This will also result in high oil consumption).

PROCEDURE:

1. Remove both spark plugs.
2. Insert a compression gauge into either cylinder.
3. Crank the engine until there is no further increase in pressure.
4. Record the highest reading obtained.
5. Repeat the procedure for the remaining cylinder and record the highest reading.

RESULTS:

Normal compression is approximately 150 psi. The difference in pressure between the two cylinders should not exceed 25 percent. If the difference is greater than 25 percent, loss of compression in the lowest reading cylinder is indicated.

***Example 1:*** *If the pressure reading of cylinder #1 is 165 psi and of cylinder #2, 160 psi, the difference is 5 psi. Divide "5" by the highest reading (165) to obtain the percentage of 3.0 percent.*

***Example 2:*** *No. 1 cylinder reads 160 psi; No. 2 cylinder reads 100 psi. The difference is 60 psi. Divide "60" by "160" to obtain "37.5" percent. Loss of compression in No. 2 cylinder is indicated.*

If compression is poor, look for one or more of the following causes:

- Loose cylinder head bolts.
- Failed cylinder head gasket.
- Burned valves or valve seats.
- Insufficient valve clearance.
- Warped cylinder head.
- Warped valve stem.
- Worn or broken piston ring(s).
- Worn or damaged cylinder bore.
- Broken connecting rod.
- Worn valve seats or valves.
- Worn valve guides.

***NOTE: Refer to Engine Service manual No. 0F6923 for further engine service information.***

## *TEST 42 - CHECK OIL PRESSURE SWITCH AND WIRE 86*

If the engine cranks and starts, then shuts down almost immediately, the cause may be one or more of the following:

- Low engine oil level.
- Low oil pressure.
- A defective oil pressure switch.

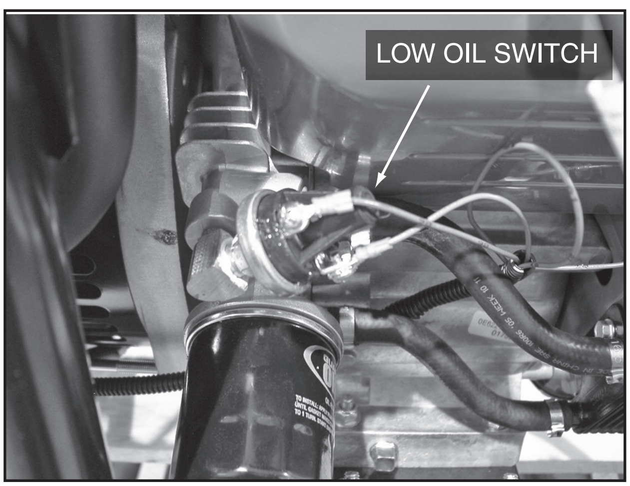



*Figure 6-53. – Low Oil Pressure Switch*

PROCEDURE:

1. Check engine crankcase oil level.
   a. Check engine oil level.
   b. If necessary, add the recommended oil to the dipstick FULL mark. DO NOT OVERFILL ABOVE THE FULL MARK.
2. Do the following:
   a. Disconnect Wire 86 and Wire 0 from the oil pressure switch terminals. Remove the switch and install an oil pressure gauge in its place.
   b. Start the engine while observing the oil pressure reading on gauge.
   c. Note the oil pressure.
      (1) Normal oil pressure is approximately 35-40 psi with engine running. If normal oil pressure is indicated, go to Step 4 of this test.
      (2) If oil pressure is below about 10 psi, shut engine down immediately. A problem exists in the engine lubrication system. Refer to Service Manual, Generac P/N 0F6923 for engine service recommendations.

***Note: The oil pressure switch is rated at 10 psi for v-twin engines.***

3. Remove the oil pressure gauge and reinstall the oil pressure switch. Do NOT connect Wire 86 or Wire 0 to the switch terminals.
   a. Set a voltmeter to measure resistance.
   b. Connect the meter test leads across the switch terminals. With engine shut down, the meter should read CONTINUITY.
   c. Crank and start the engine. The meter should read INFINITY.
   d. Connect one test lead to Wire 0 ( disconnected from LOP). Connect the other test lead to a clean frame ground. CONTINUITY should be measured. If CONTINUITY is NOT measured repair or replace Wire 0 between the LOP and the ground terminal connection on the engine mount.
4. If the LOP switch tests good in Step 3 and oil pressure is good in Step 2, but the unit still shuts down with a LOP fault, check Wire 86 for a short to ground. Set a voltmeter to measure resistance. Disconnect the J2 Connector from the circuit board. Remove Wire 86 from the LOP switch. Connect one test lead to Wire 86. Connect the other test lead to a clean frame ground. INFINITY should be measured. If CONTINUITY is measured, repair or replace Wire 86 between the LOP switch and the J2 Connector.

RESULTS:

1. If switch tests good, refer to Flow Chart.
2. Replace switch if it fails the test.

## *TEST 43 - CHECK START STOP RELAY (SSR)*

PROCEDURE:

1. Set a voltmeter to measure resistance.
2. Disconnect Wire 15 and Wire 229 from the Start Stop Relay (SSR). See Figure 6-54.
3. Connect one meter test lead to the terminal that Wire 15 was removed from. Connect the other meter test lead to the terminal that Wire 229 was removed from. Resistance measured should be approximately 100 ohms.

RESULTS:
1. If the SSR measures continuity or zero resistance it is shorted to ground and should be replaced.
2. If the SSR resistance is correct refer to flow chart.

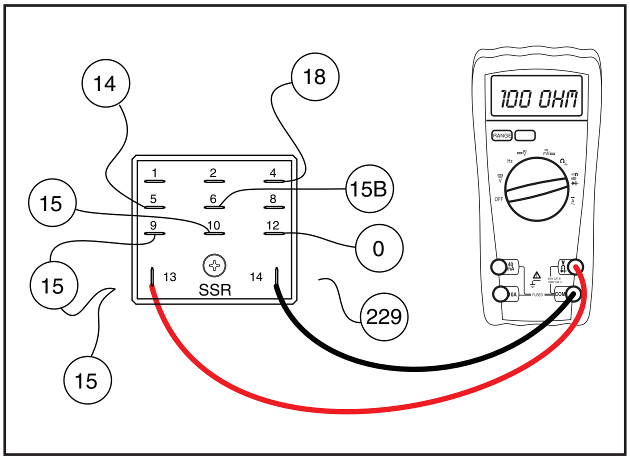


*Figure 6-54. – Testing Start Stop Relay (SSR)*

## *TEST 44 - TEST STARTER CONTACTOR RELAY (SCR)*

PROCEDURE:
1. Set a voltmeter to measure resistance.
2. Disconnect Wire 15 and Wire 17 from the Starter Contactor Relay (SCR).
3. Connect one meter test lead to the terminal that Wire 15 was removed from. Connect the other meter test lead to the terminal that Wire 17 was removed from. Resistance measured should be approximately 75 ohms.

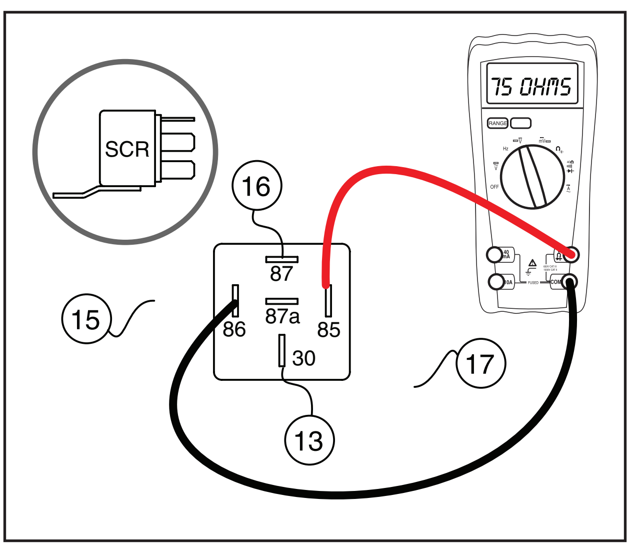


*Figure 6-55. – Testing Starter Contactor Relay (SCR)*

RESULTS:
1. If the SCR measures continuity or zero resistance it is shorted to ground and should be replaced.
2. If the SCR resistance is correct refer to flow chart.

## *TEST 45 - CHECK WIRE 15 CIRCUIT*

PROCEDURE:
1. Set a voltmeter to measure resistance.
2. Remove the Fuse (F1).
3. Disconnect all Wire 15's from the Start Stop Relay (SSR), disconnect Wire 15 from the Starter Contactor (SC), Disconnect Wire 15 from the Start-Run-Stop Switch (SW1), and disconnect Wire 15 from the Battery Charge Rectifier 2 (BCR2).
4. Remove Wire 15 from the fuse holder (F1). Connect one meter test lead to wire 15 just removed. Connect the other meter test lead to frame ground. INFINITY should be measured.

RESULTS:
If INFINITY was not measured a short on Wire 15 to ground exists. Inspect each wire 15 for a shorted condition. Repair or replace as needed.

## *TEST 46 - CHECK WIRE 14 CIRCUIT*

PROCEDURE:
1. Set a voltmeter to measure resistance.
2. Disconnect Wire 14 from the Start Stop relay (SSR).
3. Connect one meter test lead to Wire 14 previously removed. Connect the other meter test lead to frame ground. Approximately 38 ohms should be read.

RESULTS:
Refer back to flow chart.

## *TEST 47 - CHECK FUEL SHUTOFF SOLENOID (FSS)*

PROCEDURE:
1. Set a voltmeter to measure resistance.
2. Disconnect the plug from the Fuel Shutoff Solenoid (FSS).
3. Connect one meter test lead to one pin on the FSS. Connect the other meter test lead to the remaining pin in the FSS. Approximately 38 ohms should be measured.
4. Connect one meter test lead to one pin on the FSS. Connect the other meter test lead to frame ground. INFINITY should be measured.

RESULTS:

1. If continuity or zero was measured in Step 3 or Step 4 replace the FSS.
2. (Units without Hourmeter) If correct resistance was measured refer to flow chart, repair or replace Wire 14 between the FSS and Resistor (R1).
3. (Units with Hourmeter) Refer back to flow chart.

## TEST 48 - CHECK HOURMETER

PROCEDURE:

1. Disconnect Wire 14 from the hourmeter. Install new 10 Amp fuse. Set Start Run Stop Switch (SW1) to start.
2. Check to see if fuse blew open.

RESULTS:

1. If fuse did not blow open replace the hour meter.
2. If fuse still blew repair or replace Wire 14 between the Resistor (R1) and the Hour Meter (HM) or between the HM and the Fuel Shutoff Solenoid (FSS).

## TEST 49 - CHECK WIRE 15B

PROCEDURE:

1. Set a voltmeter to measure resistance.
2. Disconnect Wire 15B from the Start Stop Relay (SSR) (see Figure 6-56) . Connect one meter test lead to Wire 15B previously removed. Connect the other meter test lead to frame ground. Approximately 20K ohms should be measured.
3. If continuity or zero resistance was measured remove the J2 connector from the printed circuit board and repeat Step 2.

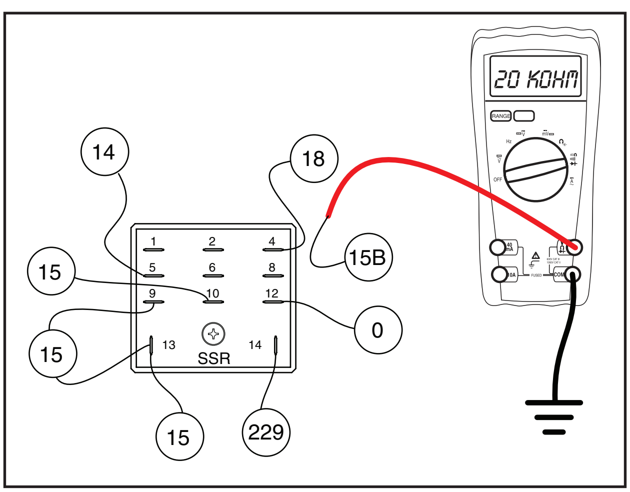



*Figure 6-56. – Check Wire 15B*

RESULTS:

1. If continuity was measured in Step 2 but not in Step 3, replace the printed circuit board.
2. If continuity was measured in Step 3, Wire 15B is shorted to ground, repair or replace Wire 15B between the SSR and printed circuit board.

## TEST 50 - CHECK WIRE 167

PROCEDURE:

1. Set a voltmeter to measure resistance.
2. Disconnect Wire 167 from the Start-Run-Stop Switch (SW1). Connect one meter test lead to Wire 167 previously removed. Connect the other meter test lead to frame ground. See Figure 6-57. INFINITY should be measured.
3. If continuity or zero resistance was measured remove the J2 connector from the printed circuit board and repeat Step 2.

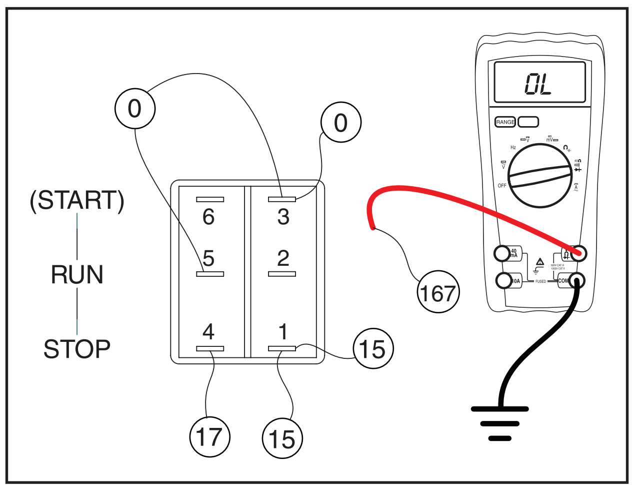



*Figure 6-57. Check Wire 167*

RESULTS:

1. If continuity was measured in Step 2 but not in Step 3, replace the printed circuit board.
2. If continuity was measured in Step 3 wire 167 is shorted to ground, repair or replace Wire 167 between the SW1 and printed circuit board.

## TEST 51 - CHECK WIRES 11S & 44S

PROCEDURE:

1. Set a voltmeter to measure resistance.
2. Disconnect the J2 connector from the printed circuit board.

Connect one meter test lead to pin location J2-10 Wire 44S of the connector just removed. Be careful not to damage the pin connectors with the test leads. Connect the other meter test lead to Wire 44S at Terminal Block 2 (TB2). CONTINUITY should be measured.

3. Connect one meter test lead to pin location J2-12 Wire 11S. Be careful not to damage the pin connectors with the test leads. Connect the other meter test lead to Wire 11S at Terminal Block 2 (TB2). CONTINUITY should be measured.

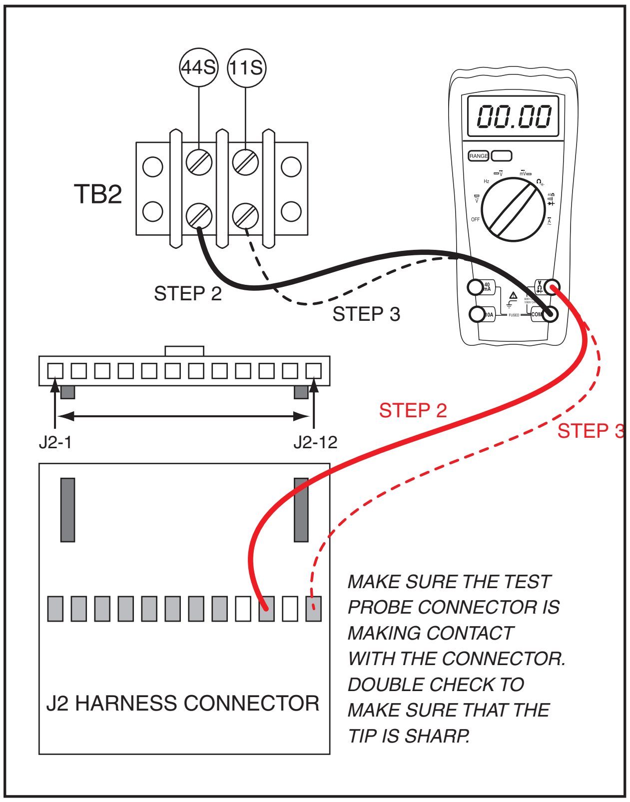



*Figure 6-58. – Check Wires 11S & 44S*

RESULTS:

1. If CONTINUITY was not measured, repair or replace the wire harness.
2. If CONTINUITY was measured, refer back to the flow chart.

## TEST 52 - CHECK IDLE CONTROL SWITCH (SW2)

PROCEDURE:

1. Set a voltmeter to measure resistance.
2. Disconnect Wire 0 and Wire 83 from the Idle Control Switch (SW2).
3. Connect meter test leads across both terminals of SW2. See Figure 6-59.
4. In the OFF position the meter should read INFINITY or Open. In the ON position the meter should read CONTINUITY or Closed.

RESULTS:

1. If the switch fails Step 4 replace it.
2. If the switch is good refer back to the flow chart.

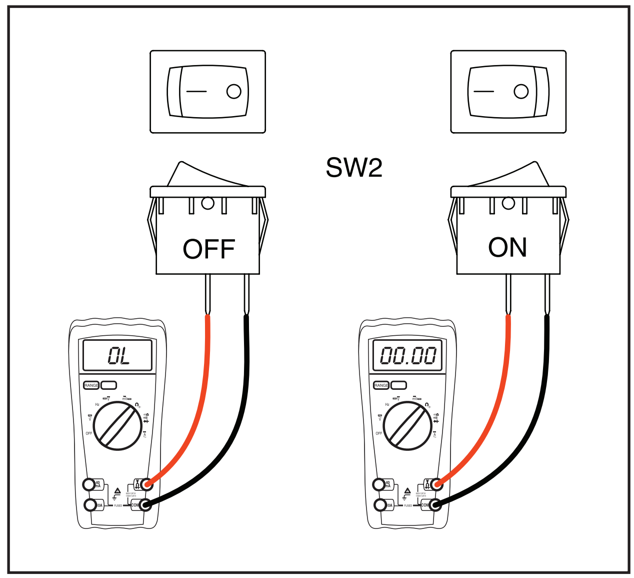



*Figure 6-59. – Check Idle Control Switch (SW2)*

## TEST 53 - CHECK IDLE CONTROL WIRING

PROCEDURE:

1. Set a voltmeter to measure resistance.
2. Disconnect Wire 0 from the Idle Control Switch (SW2).
3. Connect one meter test lead to Wire 0. Connect the other meter test lead to frame ground. CONTINUITY should be measured. If continuity is not measured repair or replace Wire 0 between SW2 and the ground terminal.
4. Disconnect Wire 83 from SW2. Disconnect the J2 connector from the printed circuit board.
5. Connect one meter test lead to Wire 83 previously removed from SW2. Connect the other meter test lead to pin location J2-2 on the J2 connector. See Figure 6-60. Be careful not to damage the pin connectors with the test leads. CONTINUITY should be measured. If CONTINUITY is not measured repair or replace Wire 83 between the J2 connector and Terminal Block or between the Terminal Block and SW2.

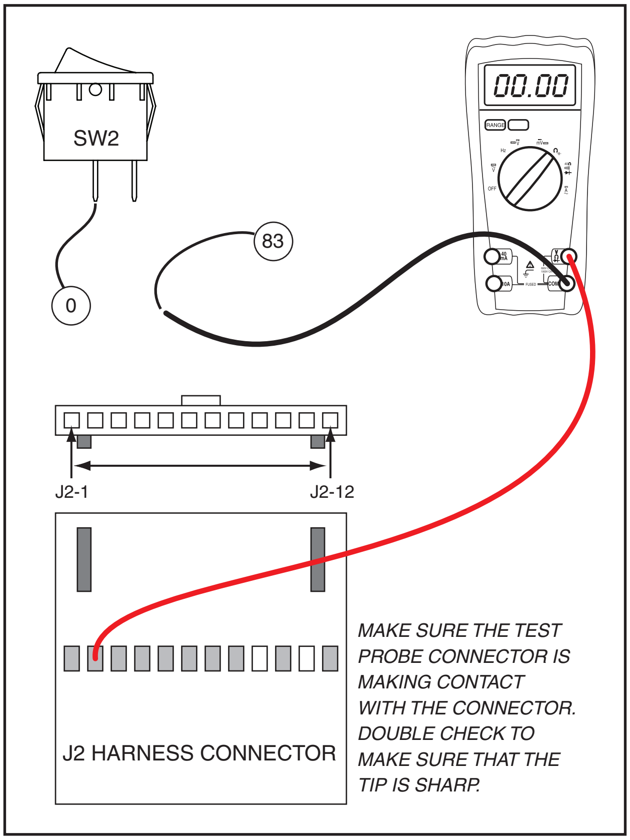



*Figure 6-60. – Check Idle Control Wiring*

RESULTS:

Repair or replace wiring as needed. Refer back to the flow chart.

## *TEST 54 - CHECK IDLE CONTROL TRANSFORMERS (ICT)*

PROCEDURE:

1. Set a voltmeter to measure resistance.
2. Remove the two Idle Control Transformer (ICT) Wires from Terminal Block 1 (TB1). See Figure 6-61.
3. Connect one meter test lead to one wire and connect the other meter test lead to the other wire. Approximately 100 ohms should be measured. If resistance is not measured repair or replace the Idle Control Transformers. If resistance was measured proceed with Step 4.
4. Set a voltmeter to measure AC Voltage.
5. Connect one meter test lead to one wire and connect the other meter test lead to the other wire.
6. Turn the Idle Control Switch (SW2) to OFF. The generator should be running at about 60 HZ.
7. Apply a light load to the generator, such as a electric drill.
8. When the drill is activated measure the voltage output. The AC voltage should measure around 1-2 VAC.

RESULTS:

Refer back to flow chart.

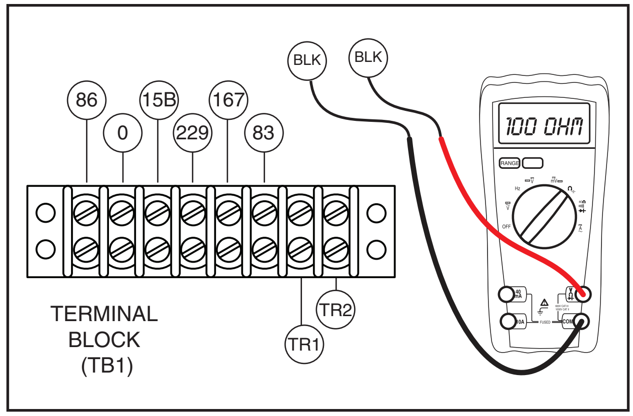



*Figure 6-61. Check Idle Transformer Wiring*

## *TEST 55 - CHECK TR1 & TR2 WIRING*

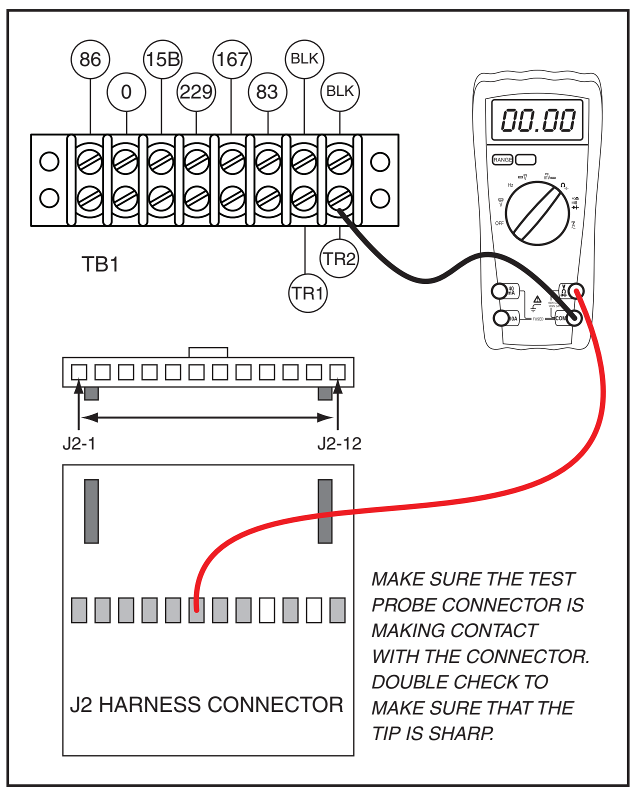



*Figure 6-62. – Check TR2 Wiring*

PROCEDURE:

1. Set a voltmeter to measure resistance.
2. Disconnect the J2 connector from the printed circuit board.
3. Connect one meter test lead to Wire TR2 at Terminal Block 1 (TB1). See Figure 6-62. Connect the other meter test lead to pin location J2-6 on the J2 Connector previously removed. Be careful not to damage the pin connectors with the test leads. Continuity should be measured.
4. Connect one meter test lead to Wire TR1 at Terminal Block 1 (TB1). See Figure 6-63. Connect the other meter test lead to pin location J2-3 on the J2 Connector previously removed. Be careful not to damage the pin connectors with the test leads. Continuity should be measured.

RESULTS:

1. Repair or replace defective wiring.
2. If wiring tests good replace printed circuit board.

## TEST 56 - CHOKE TEST

PROCEDURE:

If the generator is surging it may have a carburetion problem. A lean condition can cause erratic RPM. Slowly pull the choke out to see if surging stops. If it does stop, carburetion should be checked.

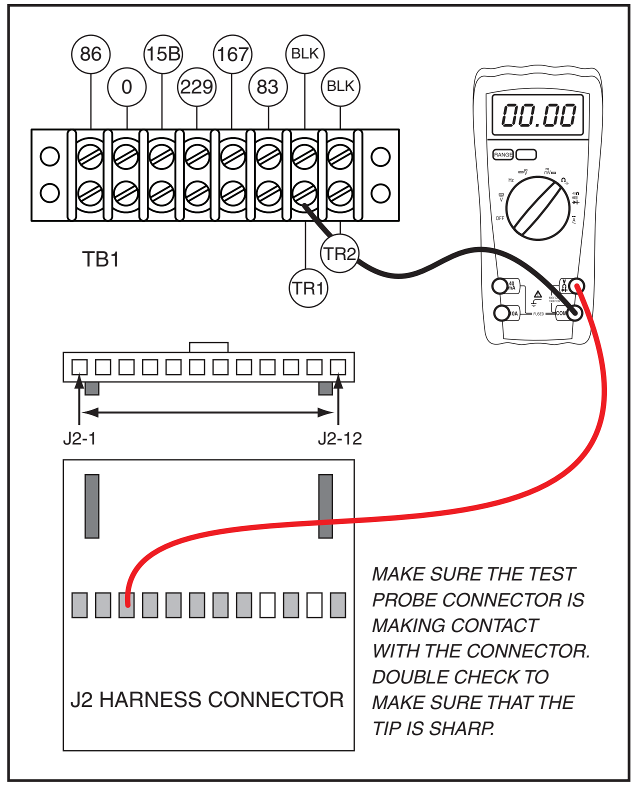



*Figure 6-63. – Check TR1 Wiring*

## *MAJOR DISASSEMBLY*

<u>STATOR, ROTOR, AND ENGINE REMOVAL.</u>

Reference Figures A and B on Pages 68-71 for component location.

1. Disconnect and remove the battery (Figure B, Item #15) from the generator.
2. <u>Remove Fuel Tank</u> (Figure B, Item #4). Use proper safety precautions when handling gasoline.

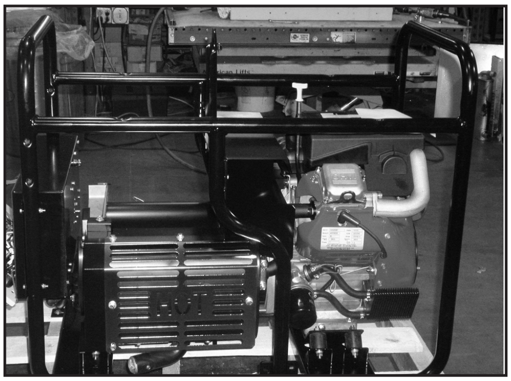


*Figure 7-1. – Fuel Tank Removed*

3. <u>Remove Control Panel.</u> (Figure B) The front control panel should be removed and Wires 11 & 44 will need to be disconnected from the 50 Amp circuit breaker and Wire 22 from the 50 Amp receptacle. Disconnect the stepper motor harness from the printed circuit board. Disconnect the C1 and C2 connectors below the control panel. Remove the control panel.

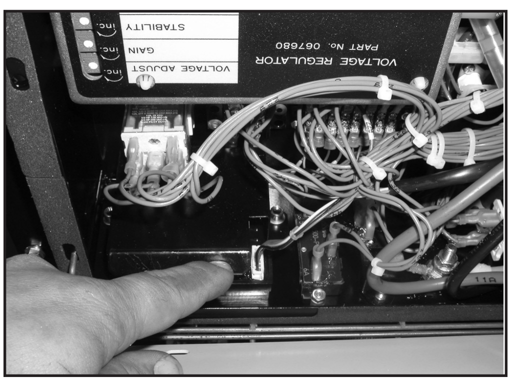



*Figure 7-2. – Stepper Motor Harness*

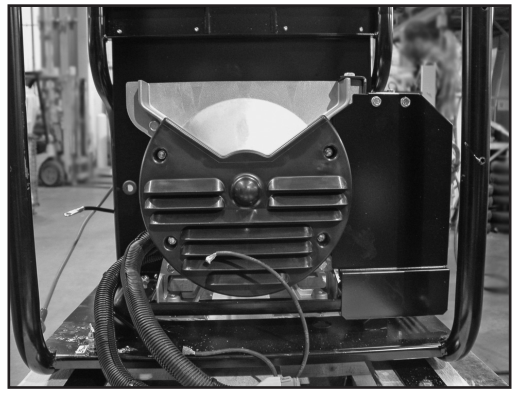


*Figure 7-3. – Control Panel Removed*

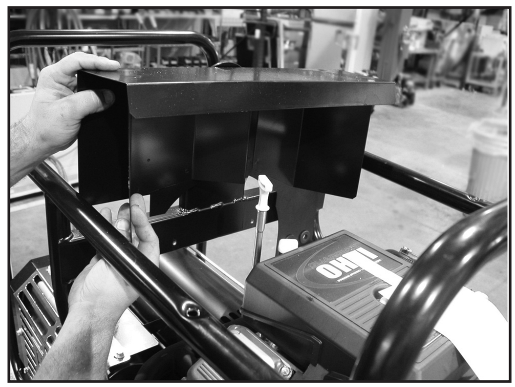


*Figure 7-4. – Remove Air Deflector*

4. Remove air deflector (Figure B, Item #45) from cross member.
5. <u>Remove the Muffler.</u> Remove the four screws holding the alternator air cover on the rear of the alternator, (Figure A, Item #8). Remove the muffler heat shield labeled HOT, Figure A, Item #34. Remove the rear muffler box end panel, (Figure A, Item #38). Remove the nut and washers from the top of the rear rubber mounts attached to the rear bearing carrier, (Figure A, Item 32). Remove the back muffler box back panel, (Figure A, Item 37). Remove the M8 bolt from the rear bearing carrier, (Figure A, Item #15). Remove the exhaust clamp, (Figure A, Item 35). Remove the muffler, (Figure A, Item #6).

*Figure 7-5. – Remove Muffler*

6. Remove Stator. Disconnect Wire 4 and Wire 0 from the brush assembly, Figure A, Item 21. Remove the brush assembly. Remove the four stator hold down bolts, Figure A, Item 12. Lift the rear end of the alternator up to clear the muffler frame from the rubber alternator mount, place a 2x4 under the front bearing carrier for support. Using a rubber mallet carefully remove the rear bearing carrier, Figure A, Item 4. Rotate the rotor so that the steel laminations face the top and bottom. Remove the stator can.

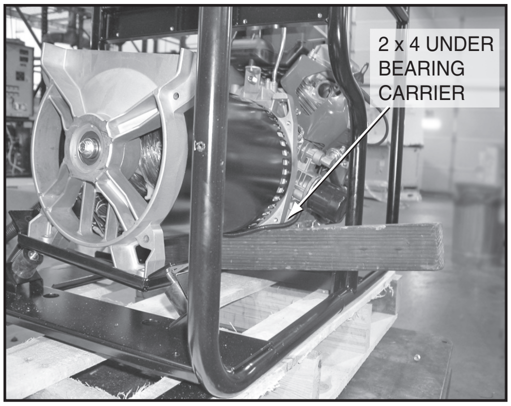



*Figure 7-6. – Support Alternator*

7. Remove Rotor. Remove rotor bolt, Figure A, Item 11. Cut 2.5 inches from the hex head end of the rotor bolt. Slot the end of the bolt to suit a flat blade screwdriver. Slide the rotor bolt back through the rotor and use a screwdriver to screw it into the crankshaft. Use a 3” M12 x 1.75 bolt to screw into the rotor. Apply torque to the 3” bolt until the taper breaks. If necessary, when torque is applied to the 3” bolt, use a rubber mallet on the end of the rotor shaft to break the taper.

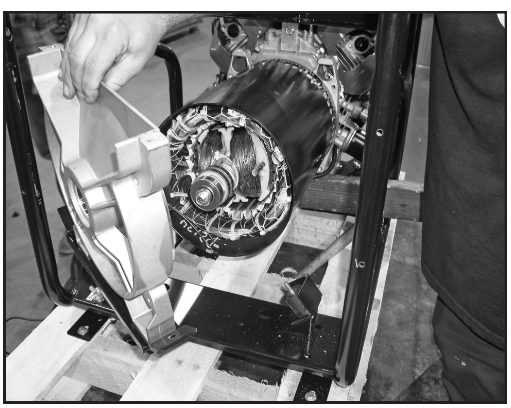


*Figure 7-7. – Remove Bearing Carrier*

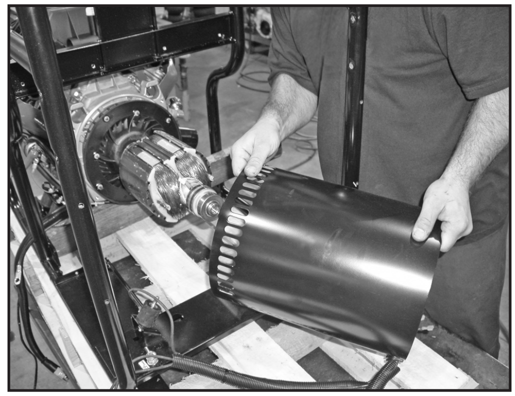


*Figure 7-8. – Remove Stator*

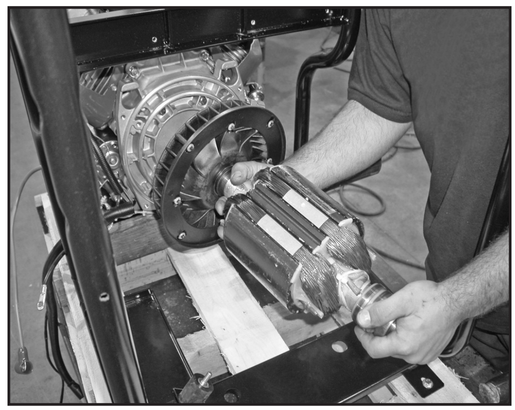


*Figure 7-9. – Remove Rotor*

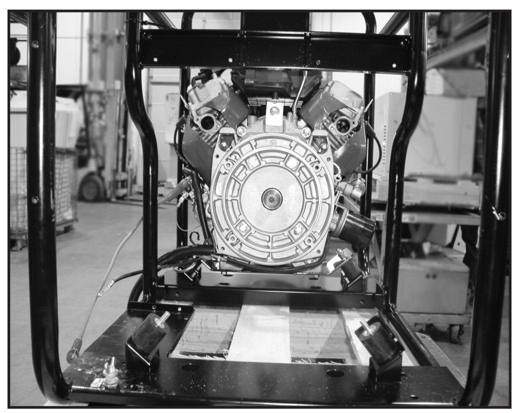
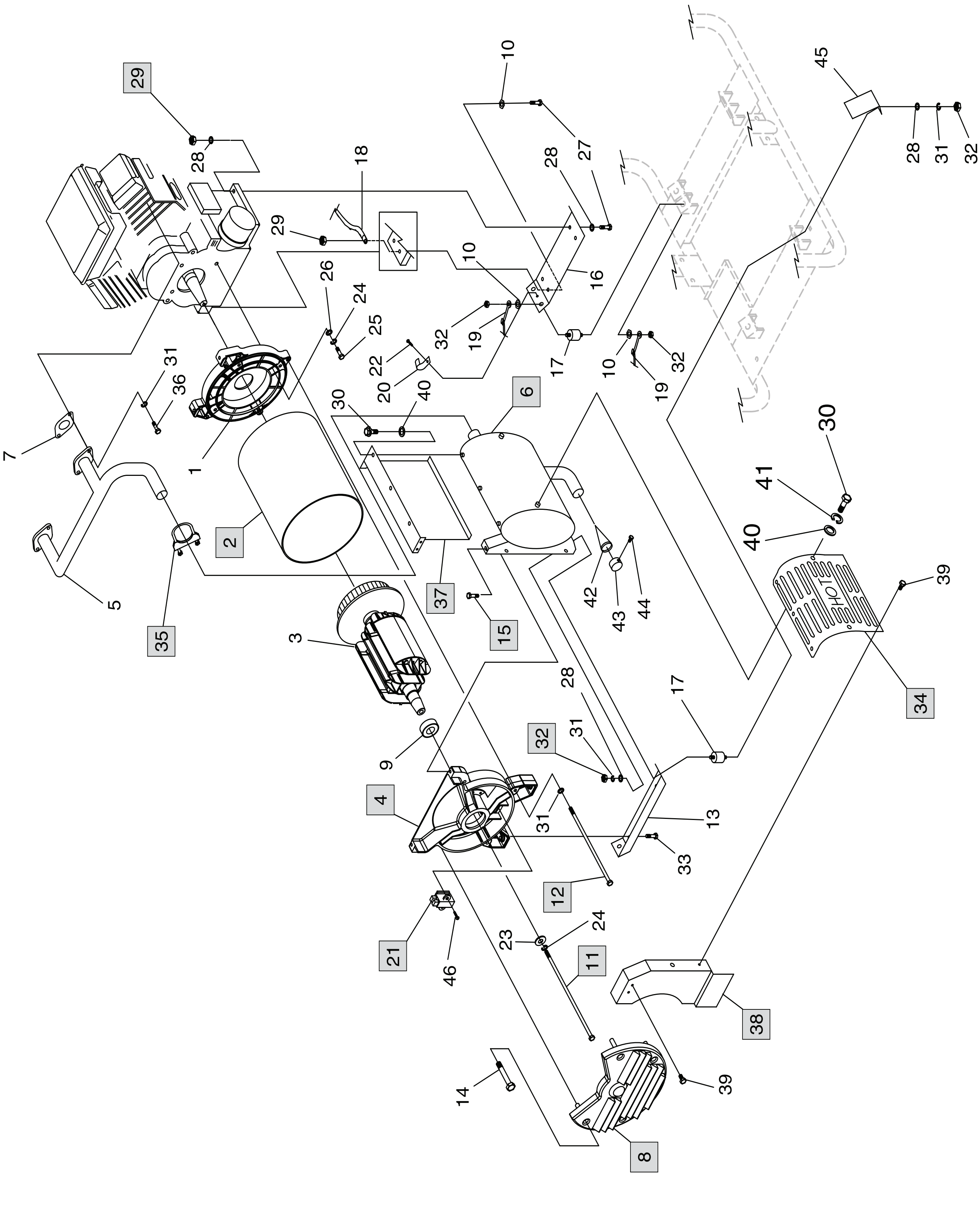


*Figure 7-10. – Engine Ready for Removal*

8. Remove Engine. Remove the four nuts from rubber engine mounts (Figure A, Item #29). Remove engine.

Reverse procedure for assembly.

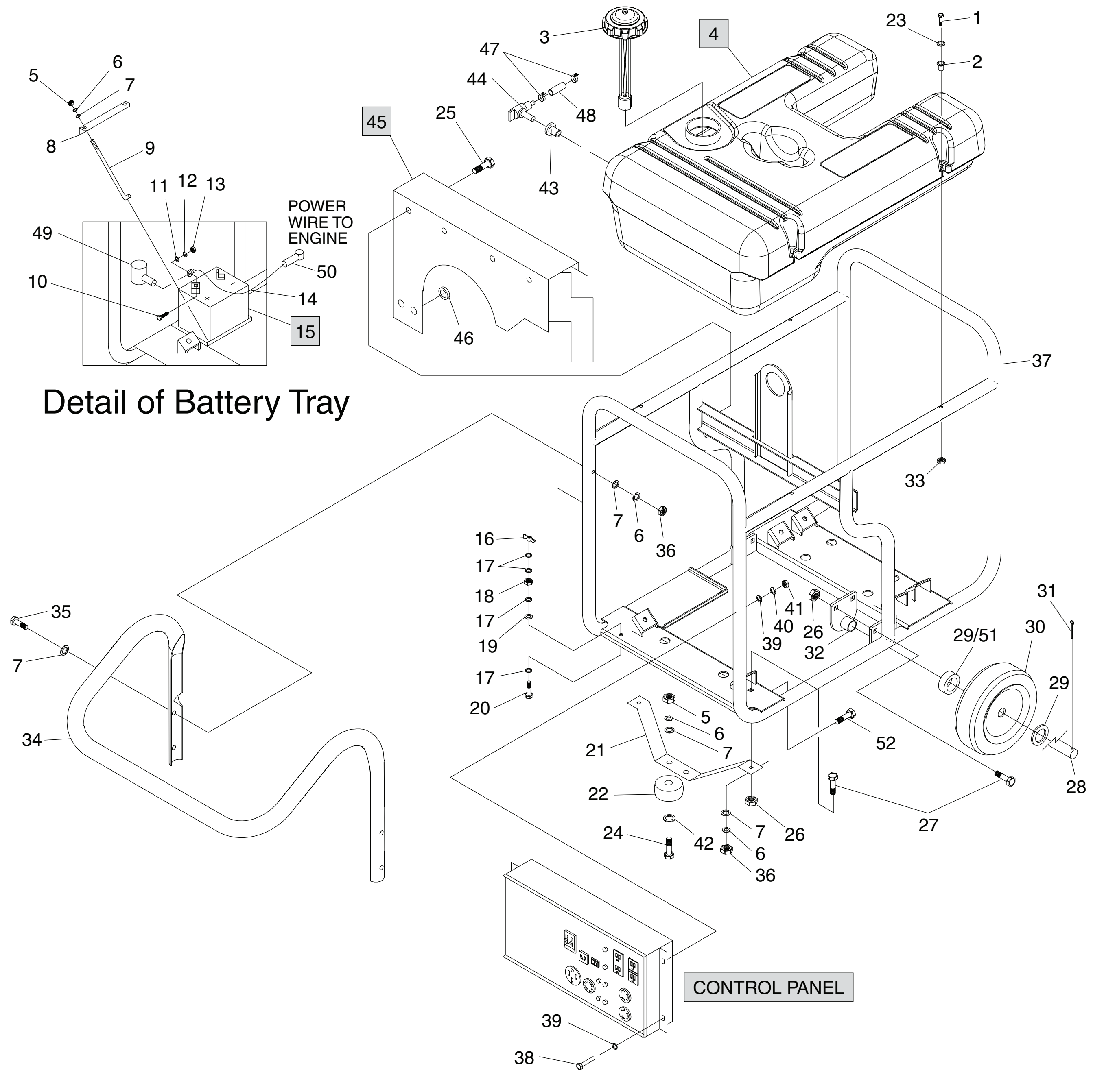
### Generator – Figure A



| ITEM | QTY. | DESCRIPTION |
|---|---|---|
| 1 | 1 | ADAPTOR, ENGINE |
| 2 | 1 | STATOR |
| 3 | 1 | ASSEMBLY, ROTOR W/FAN |
| 4 | 1 | CARRIER, REAR BEARING |
| 5 | 1 | EXHAUST MANIFOLD |
| 6 | 1 | MUFFLER |
| 7 | 1 | GASKET, EXHAUST |
| 8 | 1 | COVER, ALTERNATOR AIR INTAKE |
| 9 | 1 | BEARING |
| 10 | 3 | 5/16 SPECIAL LOCK WASHER |
| 11 | 1 | SCREW IHHC 3/8-24 X 15.50 G5 |
| 12 | 4 | SCREW IHHC M8-1.25 X 400 G8.8 |
| 13 | 1 | BRACKET, ALT MOUNTING |
| 14 | 4 | SCREW HHTT #10-32 X 1.75 |
| 15 | 1 | SCREW HHTT M8-1.2 X 20 |
| 16 | 1 | ENGINE MOUNTING PLATE |
| 17 | 6 | RUBBER MOUNT |
| 18 | 1 | BATTERY CABLE, BLACK |
| 19 | 1 | EARTH STRAP 3/8X 3/8 |
| 20 | 1 | CLIP-J VINYL COAT .625 ID |
| 21 | 1 | ASSEMBLY, BRUSH HOLDER |
| 22 | 1 | SCREW TAP-R #10-32 X 9/16 |
| 23 | 1 | WASHER FLAT 3/8 ZINC |

| ITEM | QTY. | DESCRIPTION |
|---|---|---|
| 24 | 5 | WASHER LOCK 3/8 |
| 25 | 4 | SCREW HHC 3/8-16 X 1-1/4 G5 |
| 26 | 4 | WASHER FLAT 3/8-M10 ZINC |
| 27 | 4 | SCREW HHC M8-1.25 X 50 G8.8 |
| 28 | 21 | WASHER FLAT 5/16 ZINC |
| 29 | 4 | NUT LOCK HEX M8-1.25 NYLON INSERT |
| 30 | 7 | SCREW HHC M6-1.0 X 12 |
| 31 | 18 | WASHER LOCK M8-5/16 |
| 32 | 12 | NUT HEX 5/16-18 STEEL |
| 33 | 2 | SCREW TAPTITE 3/8-16 X 3/4 BP |
| 34 | 1 | SHIELD, MUFFLER HEAT |
| 35 | 1 | U-BOLT & SADDLE |
| 36 | 4 | SCREW SHC M8-1.25 X 18 |
| 37 | 1 | PANEL, MUFFLER BOX BACK |
| 38 | 1 | PANEL, MUFFLER BOX END |
| 39 | 3 | SCREW HHTT M6-1.0 X 12 |
| 40 | 7 | WASHER FLAT M6-1/4 |
| 41 | 7 | WASHER LOCK M6-1/4 |
| 42 | 1 | SPARK ARRESTOR SCREEN |
| 43 | 1 | RETAINER, SPARK ARREST SCREEN |
| 44 | 1 | SCREW HHTT M4-0.7 X 8 |
| 45 | 1 | SHIELD, RUBBER MOUNT |
| 46 | 2 | SCREW HHTT M5-0.8 X 16 |

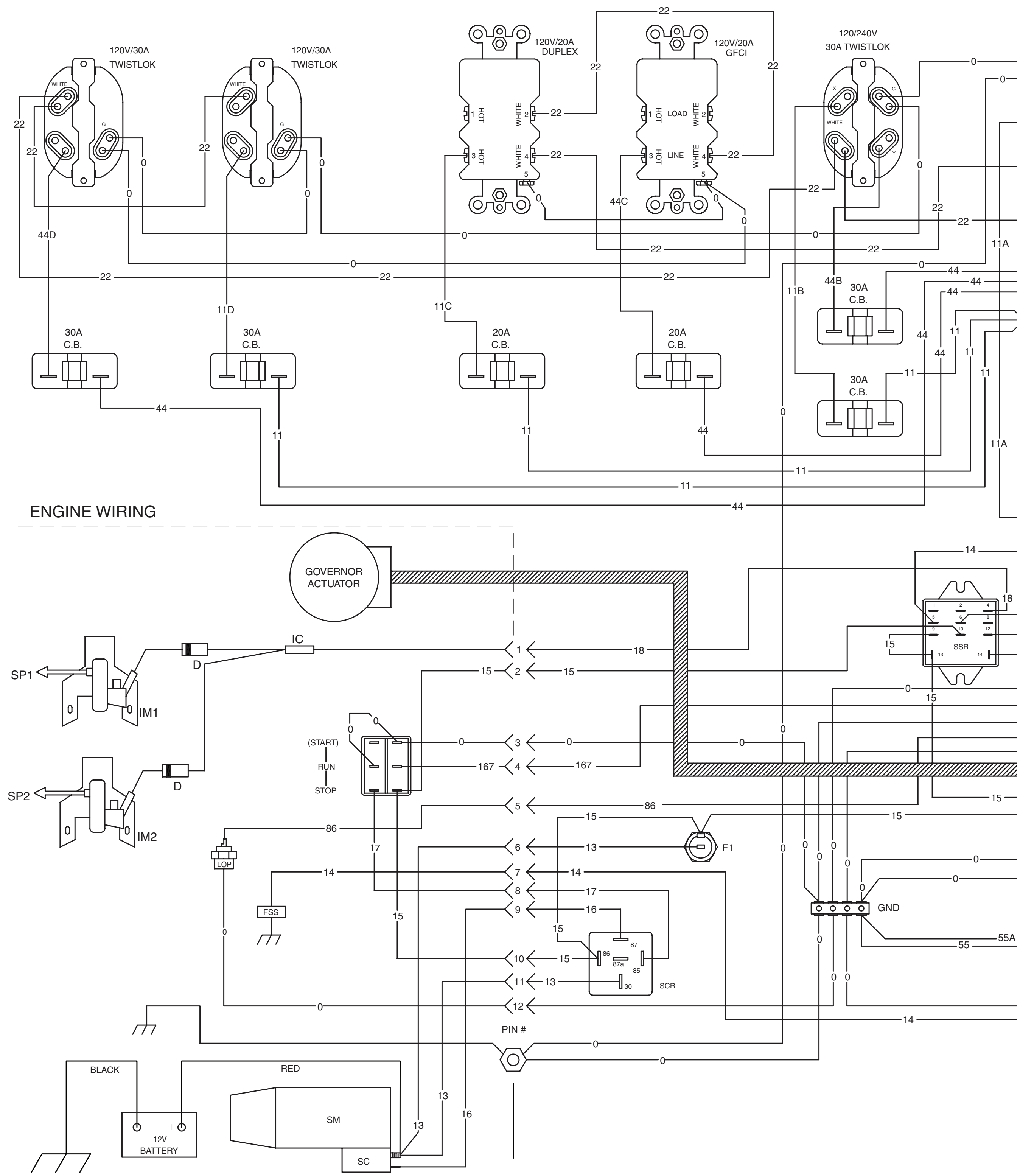
**Frame, Handle & Wheels – Figure B**

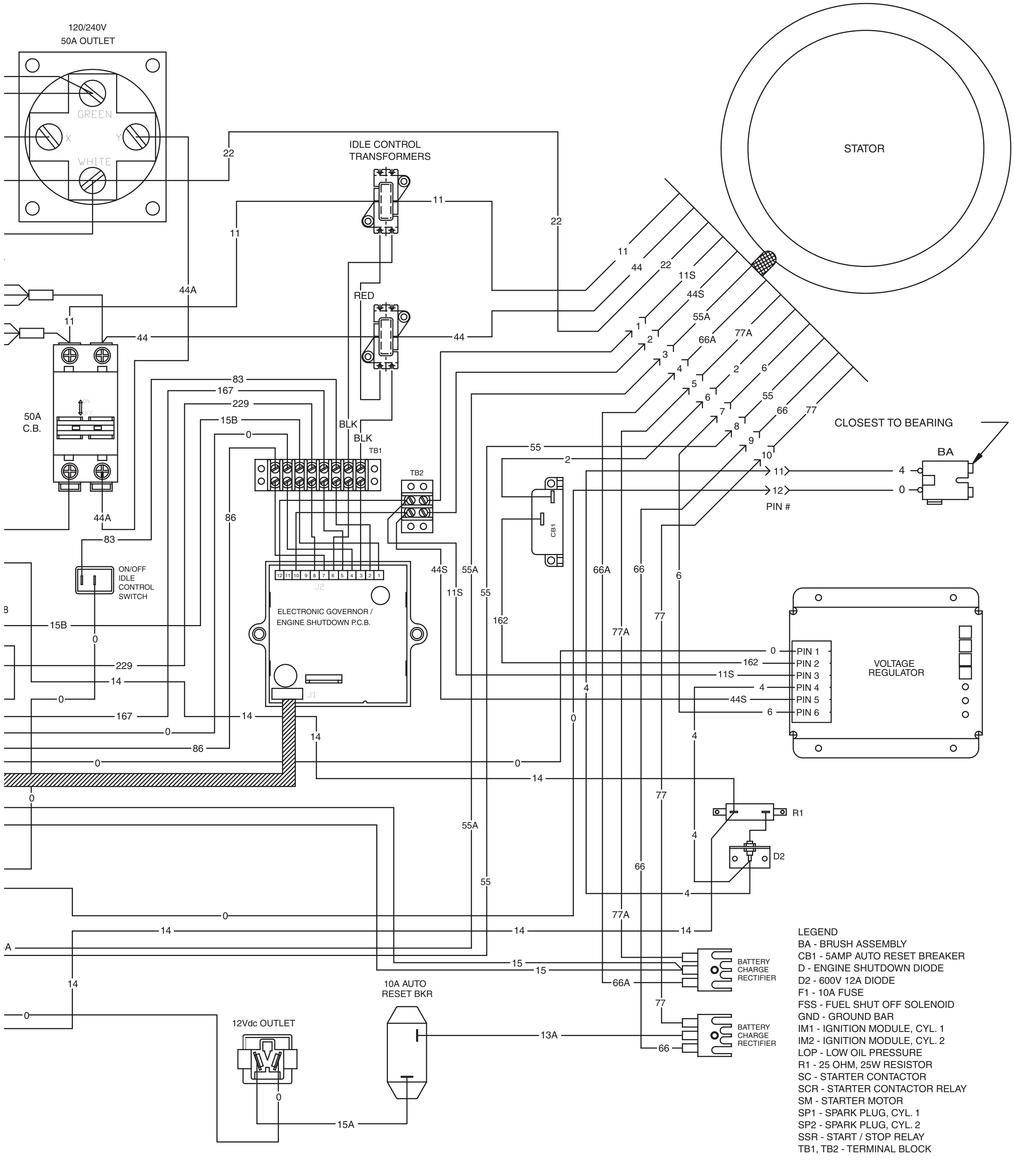


| ITEM | QTY. | DESCRIPTION |
|---|---|---|
| 1 | 4 | SCREW HHC M6-1.0 X 55 |
| 2 | 4 | RUBBER TANK MOUNT |
| 3 | 1 | CAP, FUEL WITH GAUGE & VENT |
| 4 | 1 | KIT, FUEL TANK |
| 5 | 4 | NUT HEX M8-1.25 |
| 6 | 10 | WASHER LOCK M8-5/16 |
| 7 | 14 | WASHER FLAT 5/16 |
| 8 | 1 | BRACKET BATTERY |
| 9 | 2 | BOLT,BATTERY J-BOLT |
| 10 | 2 | SCREW HHC 1/4-20 X 3/4 G5 |
| 11 | 2 | WASHER FLAT 1/4 |
| 12 | 2 | WASHER LOCK M6-1/4 |
| 13 | 2 | NUT HEX 1/4-20 |
| 14 | 1 | BATTERY CABLE, RED |
| 15 | 1 | BATTERY U1 |
| 16 | 1 | NUT WING 5/16-18 BRASS |
| 17 | 4 | WASHER FLAT 5/16 BRASS |
| 18 | 1 | NUT HEX 5/16-18 BRASS |
| 19 | 1 | 5/16 SPECIAL L/WASH |
| 20 | 1 | SCREW HHC 5/16-18 X 1.5 BRASS |
| 21 | 1 | BRACKET FRONT FOOT |
| 22 | 2 | VIB MOUNT |
| 23 | 4 | WASHER FLAT .25ID X 1”OD |
| 24 | 2 | SCREW HHC M8-1.25 X 30 |
| 25 | 4 | SCREW HHTT M6-1.0 X 12 |
| 26 | 6 | NUT LOCK FL 3/8-16 |
| 27 | 6 | BOLT CARR 3/8-16 X 1 |

| ITEM | QTY. | DESCRIPTION |
|---|---|---|
| 28 | 1 | AXLE, 3/4”DIA X 30” (15 kW)<br>AXLE, 3/4”DIA X 27.25” (12.5 kW) |
| 29 | 2<br>4 | WASHER FLAT 3/4” (15 kW)<br>WASHER FLAT 3/4” (12.5 kW) |
| 30 | 2 | 12.3” PNEUM WHEEL 3/4” AXLE (15 kW)<br>10” PNEUM WHEEL 3/4” AXLE (12.5 kW) |
| 31 | 2 | PIN COTTER 1/8 X 1-1/4 |
| 32 | 2 | BRACKET, WHEEL SPACER |
| 33 | 4 | NUT FLANGE M6-1.0 NYLOK |
| 34 | 1 | HANDLE |
| 35 | 4 | SCREW HHC 5/16-18 X 2-1/2 G5 |
| 36 | 6 | NUT LOCK HEX 5/16-18 NYLON INSERT |
| 37 | 1 | FRAME |
| 38 | 4 | SCREW HHC M5-0.8 X 45 G8.8 |
| 39 | 8 | WASHER FLAT M5 |
| 40 | 4 | WASHER LOCK M5 |
| 41 | 4 | NUT HEX M5-0.8 |
| 42 | 2 | WASHER FLAT 1” |
| 43 | 1 | BUSHING TANK DEXTOR |
| 44 | 1 | VALVE, PLASTIC TANK |
| 45 | 1 | AIR DEFLECTOR |
| 46 | 2 | GROMMET .75 X .06 X .50 |
| 47 | 2 | CLAMP HOSE BAND ¼ |
| 48 | 18” | HOSE ¼ ID |
| 49 | 1 | BOOT BATTERY CABLE |
| 50 | 1 | BOOT STARTER CABLE |
| 51 | 2 | SPACER, AXLE (15 kW) |
| 52 | 2 | SCREW HHC 5/16”-18 X 1” |

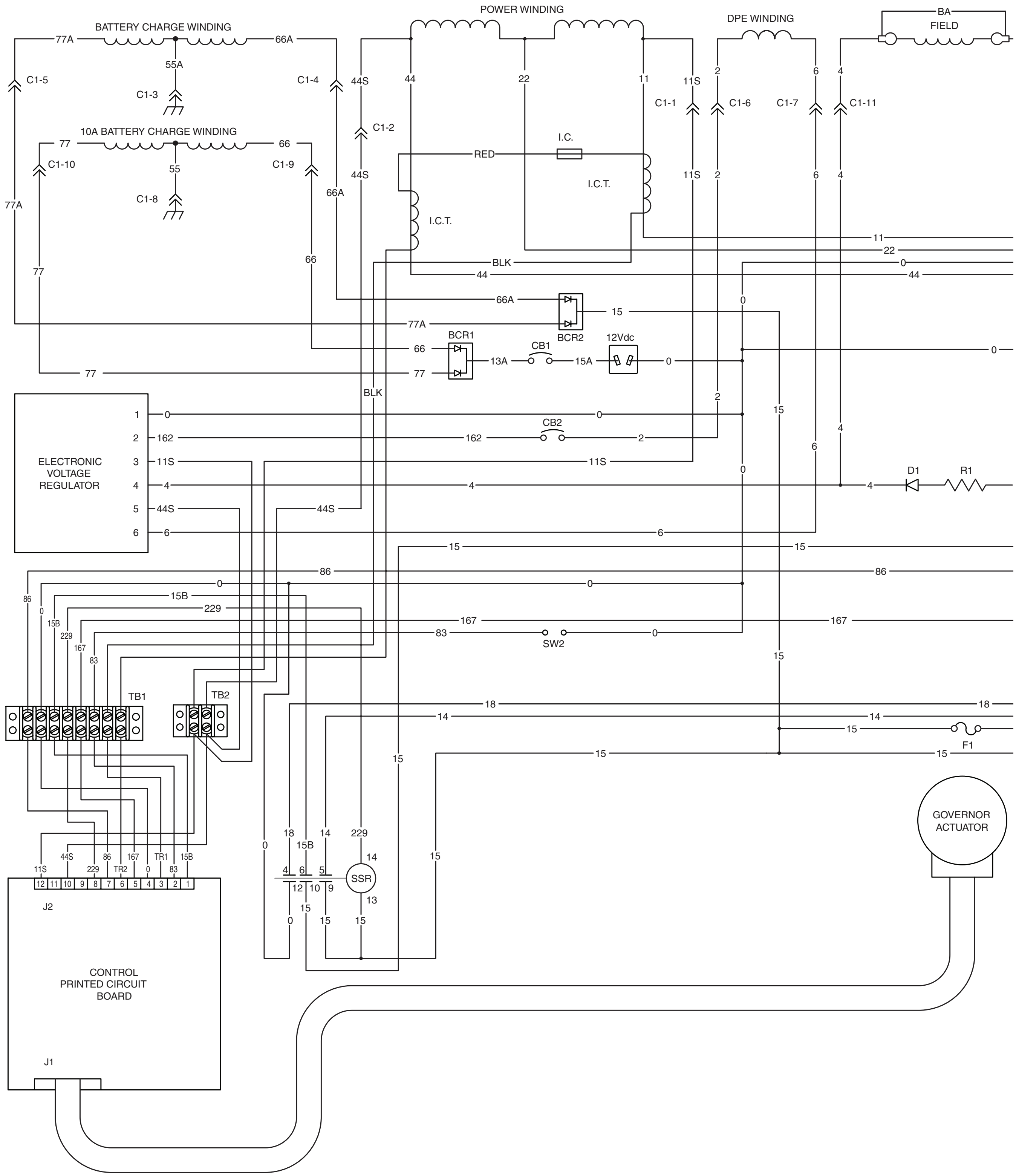
## Wiring Diagram 12.5 & 15 kW (Units Without Hourmeter) – Drawing No. 0E0228

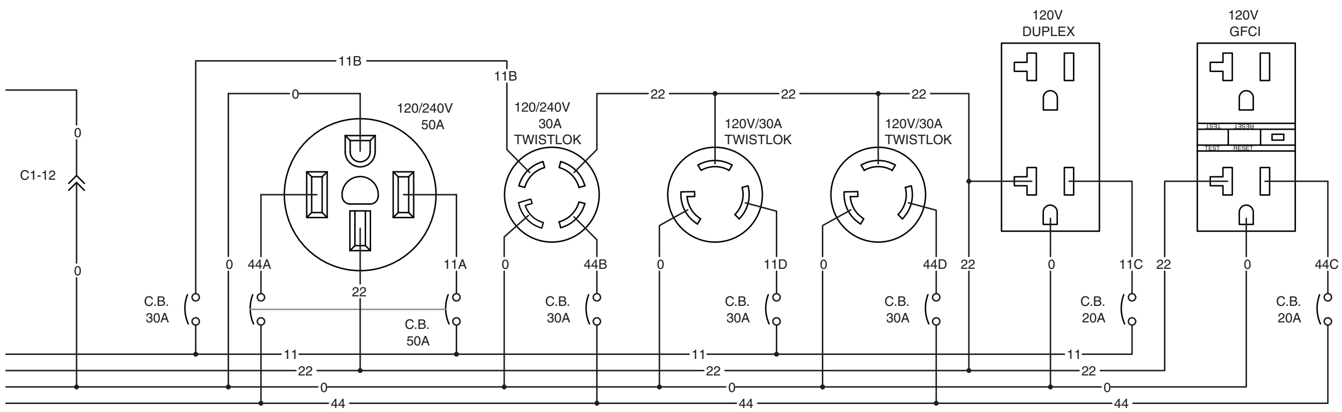


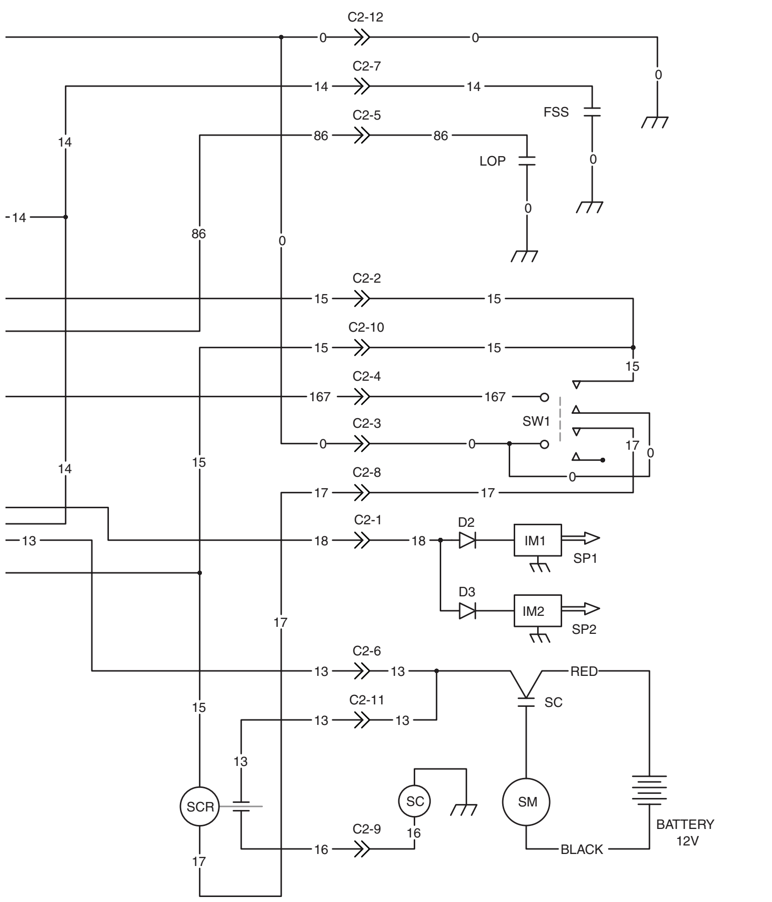



LEGEND
- BA - BRUSH ASSEMBLY
- CB1 - 5AMP AUTO RESET BREAKER
- D - ENGINE SHUTDOWN DIODE
- D2 - 600V 12A DIODE
- F1 - 10A FUSE
- FSS - FUEL SHUT OFF SOLENOID
- GND - GROUND BAR
- IM1 - IGNITION MODULE, CYL. 1
- IM2 - IGNITION MODULE, CYL. 2
- LOP - LOW OIL PRESSURE
- R1 - 25 OHM, 25W RESISTOR
- SC - STARTER CONTACTOR
- SCR - STARTER CONTACTOR RELAY
- SM - STARTER MOTOR
- SP1 - SPARK PLUG, CYL. 1
- SP2 - SPARK PLUG, CYL. 2
- SSR - START / STOP RELAY
- TB1, TB2 - TERMINAL BLOCK

## Electrical Schematic 12.5 & 15 kW (Units Without Hourmeter) – Drawing No. 0E0229-A

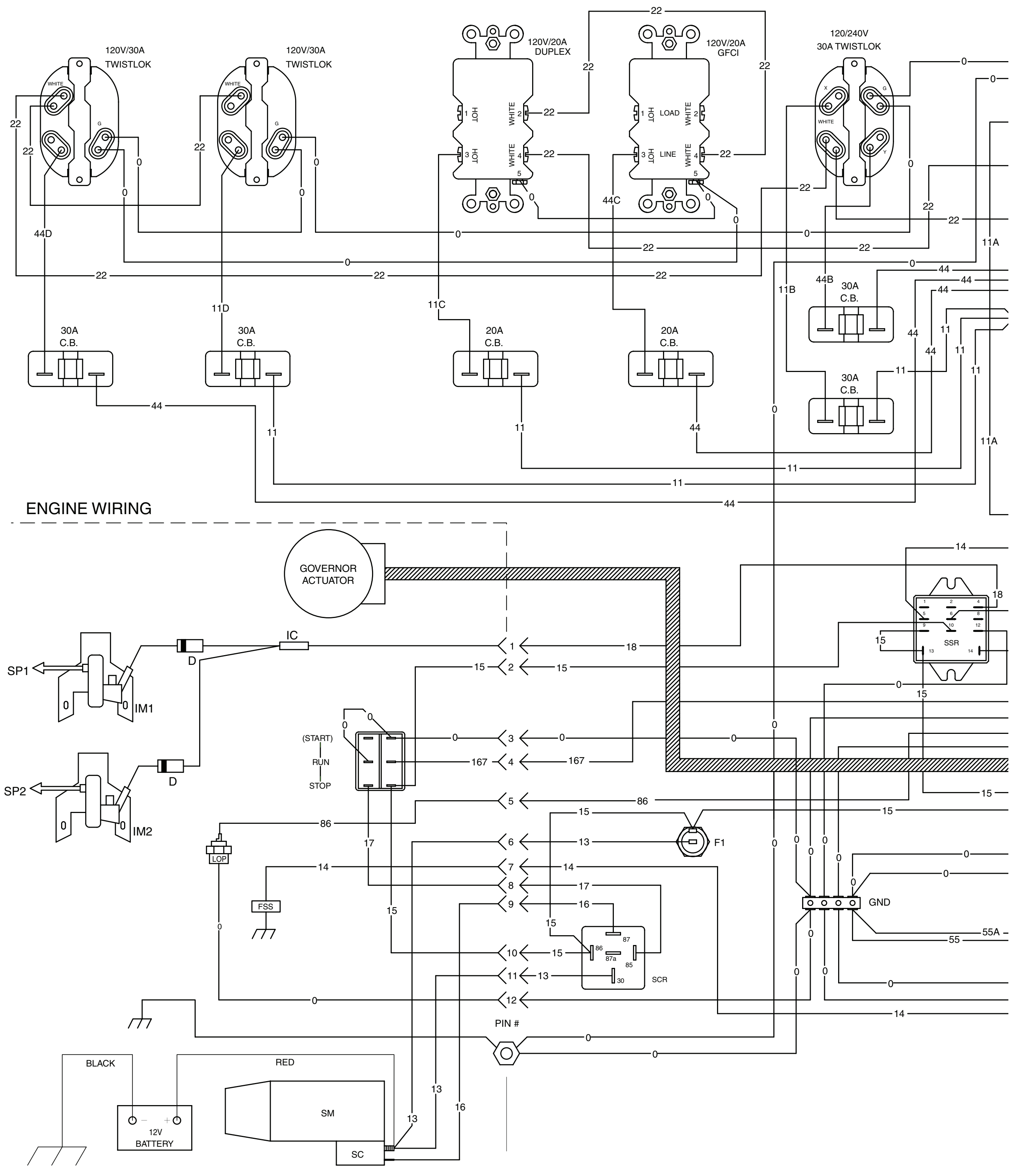


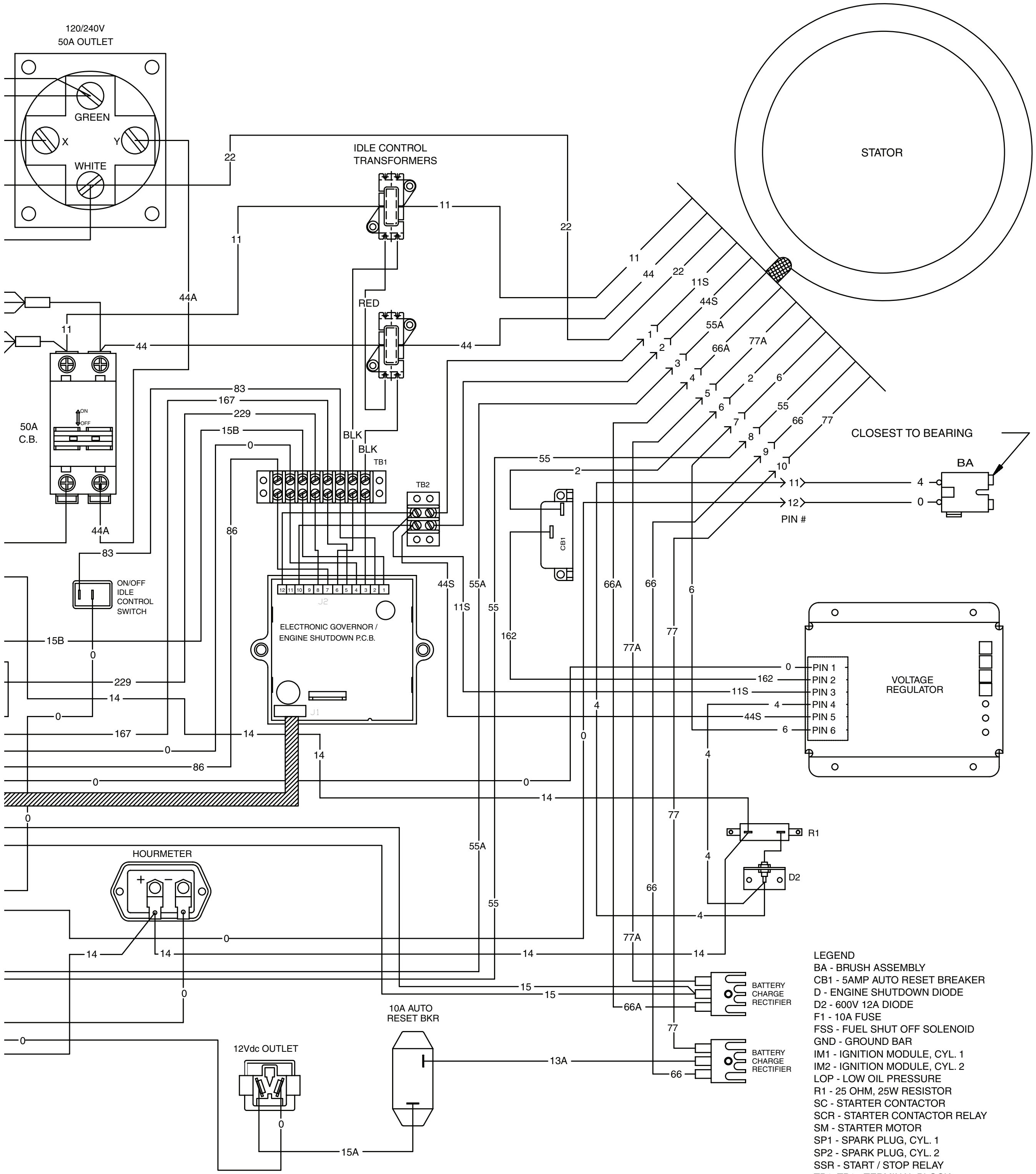


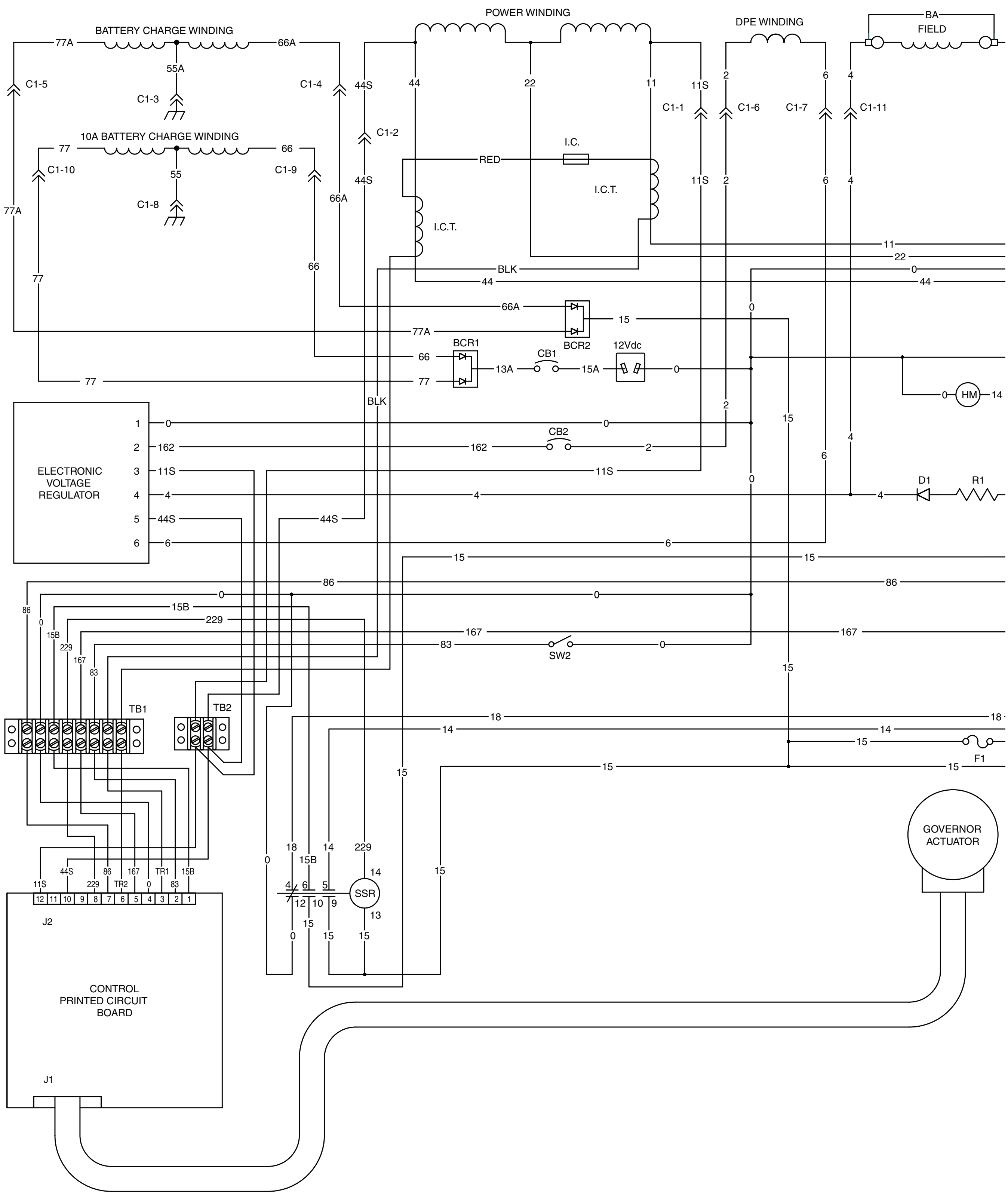

LEGEND
BA - BRUSH ASSEMBLY
BCR1 - BATTERY CHARGE RECTIFIER, 10A
BCR2 - BATTERY CHARGE RECTIFIER
CB1 - 10AMP AUTO RESET BREAKER
CB2 - 5AMP AUTO RESET BREAKER
D1 - 600V 12A DIODE
D2, D3 - ENGINE SHUTDOWN DIODE
F1 - 10A FUSE
FSS - FUEL SHUT OFF SOLENOID
GND - GROUND BAR
I.C.T. - IDLE CONTROL TRANSFORMER
IM1 - IGNITION MODULE, CYL. 1
IM2 - IGNITION MODULE, CYL. 2
LOP - LOW OIL PRESSURE
R1 - 25 OHM, 25W RESISTOR
SC - STARTER CONTACTOR
SCR - STARTER CONTACTOR RELAY
SM - STARTER MOTOR
SP1 - SPARK PLUG, CYL. 1
SP2 - SPARK PLUG, CYL. 2
SSR - START / STOP RELAY
SW1 - START-RUN-STOP RELAY
SW2 - IDLE CONTROL SWITCH
TB1, TB2 - TERMINAL BLOCK

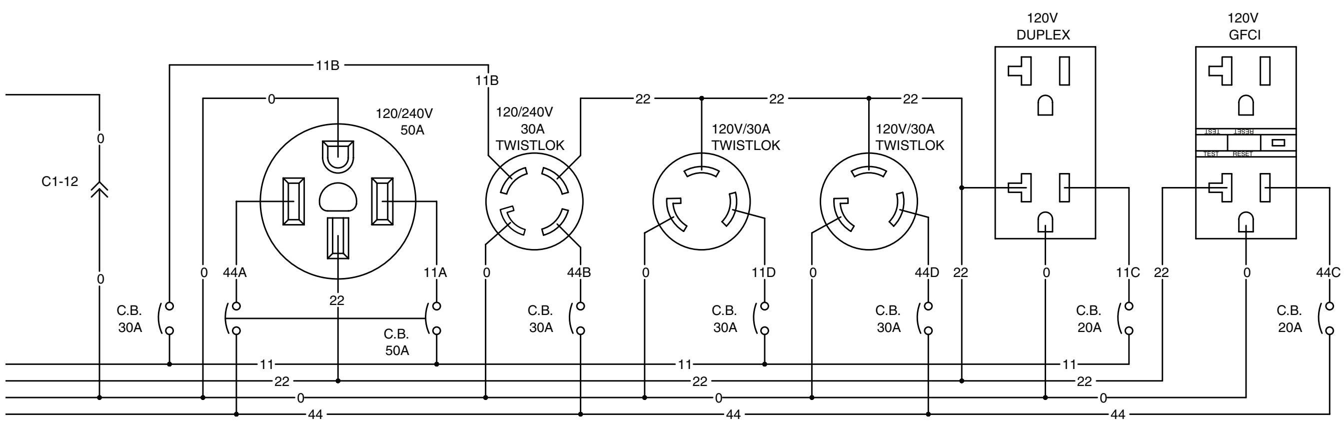
### Wiring Diagram 12.5 & 15 kW (Units With Hourmeter) – Drawing No. 0D4609-D

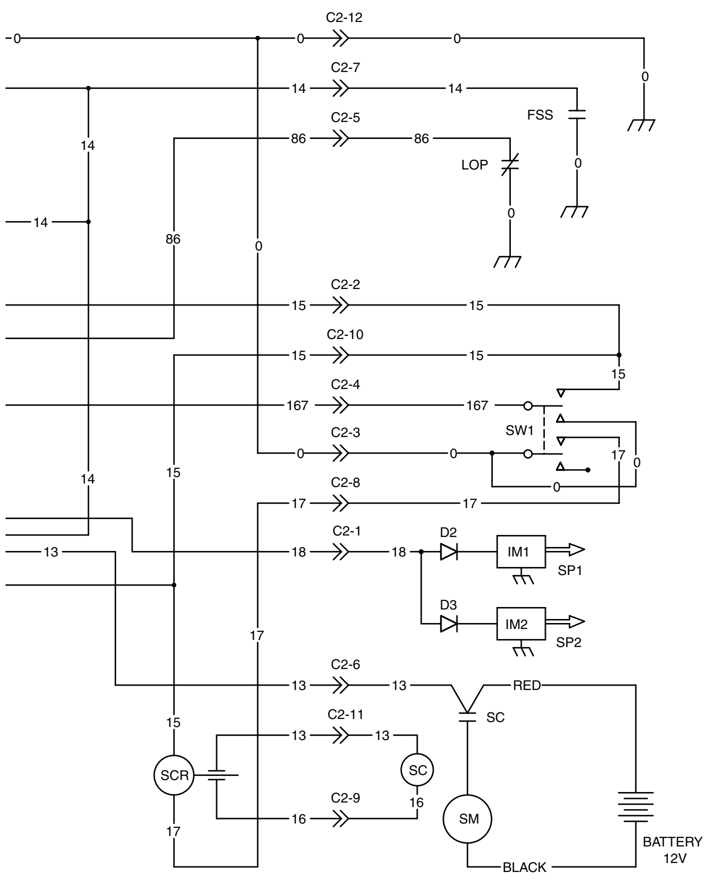



120/240V
50A OUTLET
GREEN
X
Y
WHITE
IDLE CONTROL
TRANSFORMERS
STATOR
RED
BLK
BLK
50A
C.B.
ON
OFF
TB1
TB2
ON/OFF
IDLE
CONTROL
SWITCH
ELECTRONIC GOVERNOR /
ENGINE SHUTDOWN P.C.B.
J2
J1
CB1
CLOSEST TO BEARING
BA
PIN #
PIN 1
PIN 2
PIN 3
PIN 4
PIN 5
PIN 6
VOLTAGE
REGULATOR
R1
D2
HOURMETER
BATTERY
CHARGE
RECTIFIER
BATTERY
CHARGE
RECTIFIER
10A AUTO
RESET BKR
12Vdc OUTLET
LEGEND
BA - BRUSH ASSEMBLY
CB1 - 5AMP AUTO RESET BREAKER
D - ENGINE SHUTDOWN DIODE
D2 - 600V 12A DIODE
F1 - 10A FUSE
FSS - FUEL SHUT OFF SOLENOID
GND - GROUND BAR
IM1 - IGNITION MODULE, CYL. 1
IM2 - IGNITION MODULE, CYL. 2
LOP - LOW OIL PRESSURE
R1 - 25 OHM, 25W RESISTOR
SC - STARTER CONTACTOR
SCR - STARTER CONTACTOR RELAY
SM - STARTER MOTOR
SP1 - SPARK PLUG, CYL. 1
SP2 - SPARK PLUG, CYL. 2
SSR - START / STOP RELAY
TB1, TB2 - TERMINAL BLOCK

### Electrical Schematic 12.5 & 15 kW (Units With Hourmeter) – Drawing No. 0D6297-A

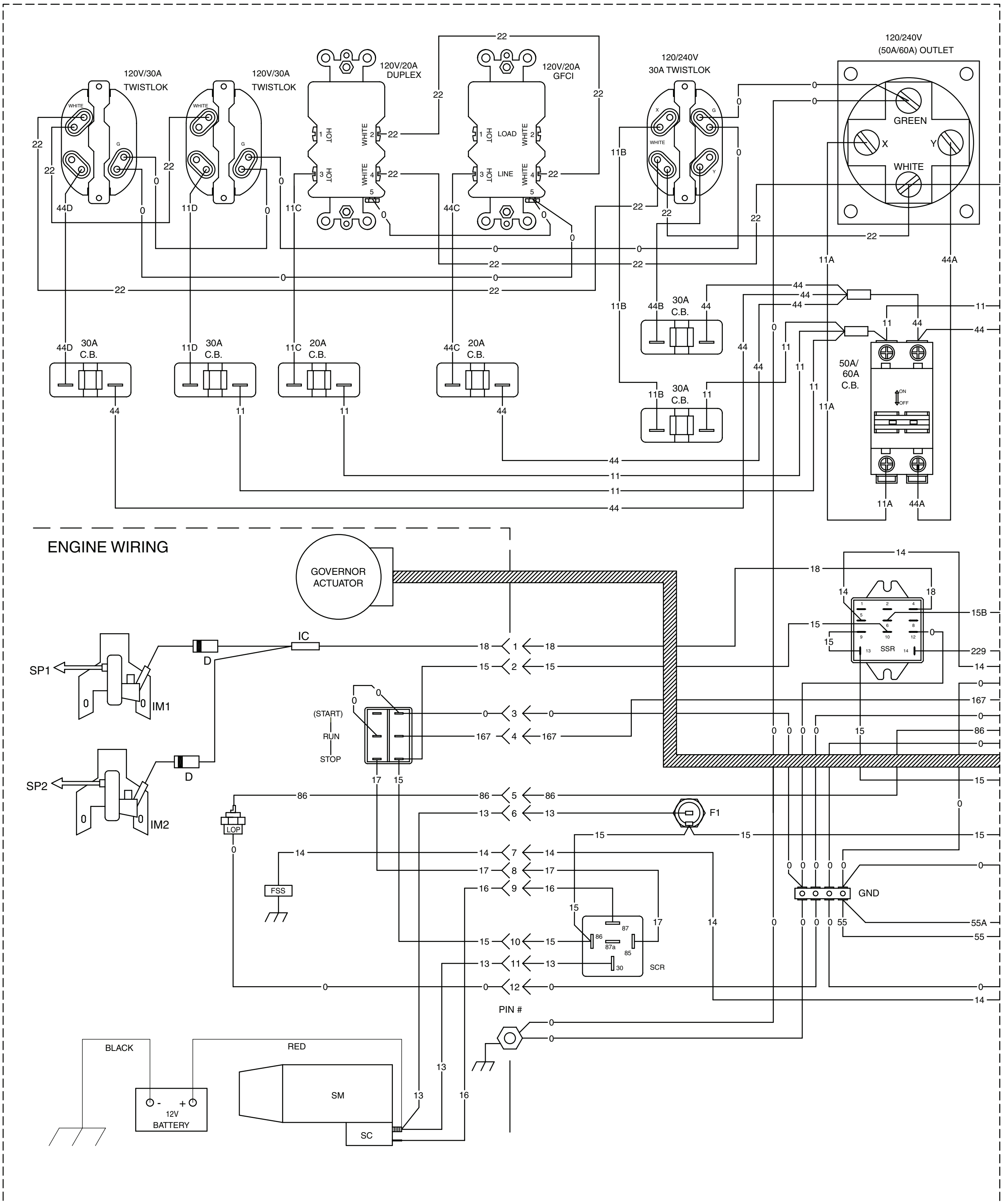


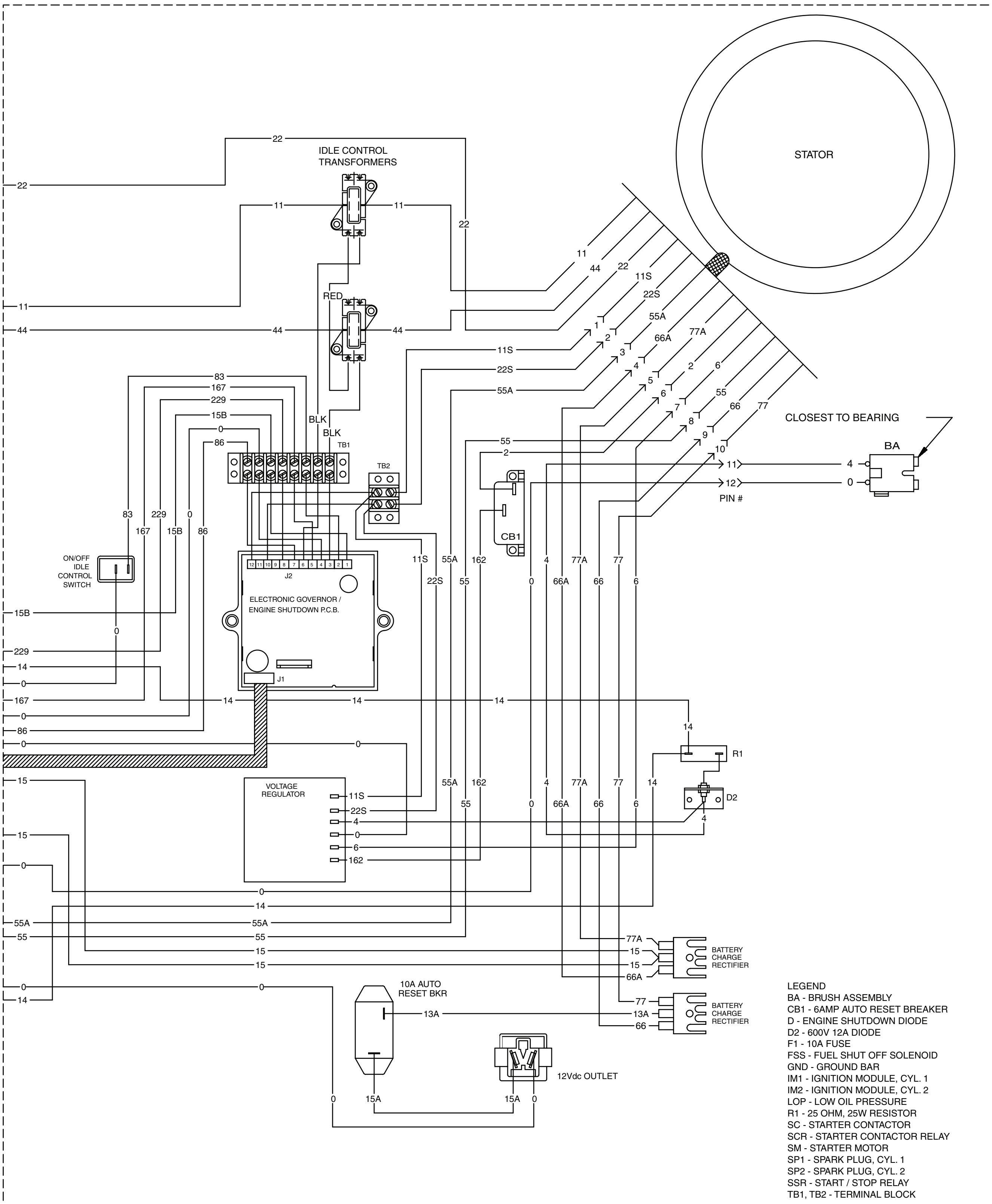



LEGEND
BA - BRUSH ASSEMBLY
BCR1 - BATTERY CHARGE RECTIFIER, 10A
BCR2 - BATTERY CHARGE RECTIFIER
CB1 - 10AMP AUTO RESET BREAKER
CB2 - 5AMP AUTO RESET BREAKER
D1 - 600V 12A DIODE
D2, D3 - ENGINE SHUTDOWN DIODE
F1 - 10A FUSE
FSS - FUEL SHUT OFF SOLENOID
GND - GROUND BAR
HM - HOURMETER
I.C.T. - IDLE CONTROL TRANSFORMER
IM1 - IGNITION MODULE, CYL. 1
IM2 - IGNITION MODULE, CYL. 2
LOP - LOW OIL PRESSURE
R1 - 25 OHM, 25W RESISTOR
SC - STARTER CONTACTOR
SCR - STARTER CONTACTOR RELAY
SM - STARTER MOTOR
SP1 - SPARK PLUG, CYL. 1
SP2 - SPARK PLUG, CYL. 2
SSR - START / STOP RELAY
SW1 - START-RUN-STOP RELAY
SW2 - IDLE CONTROL SWITCH
TB1, TB2 - TERMINAL BLOCK

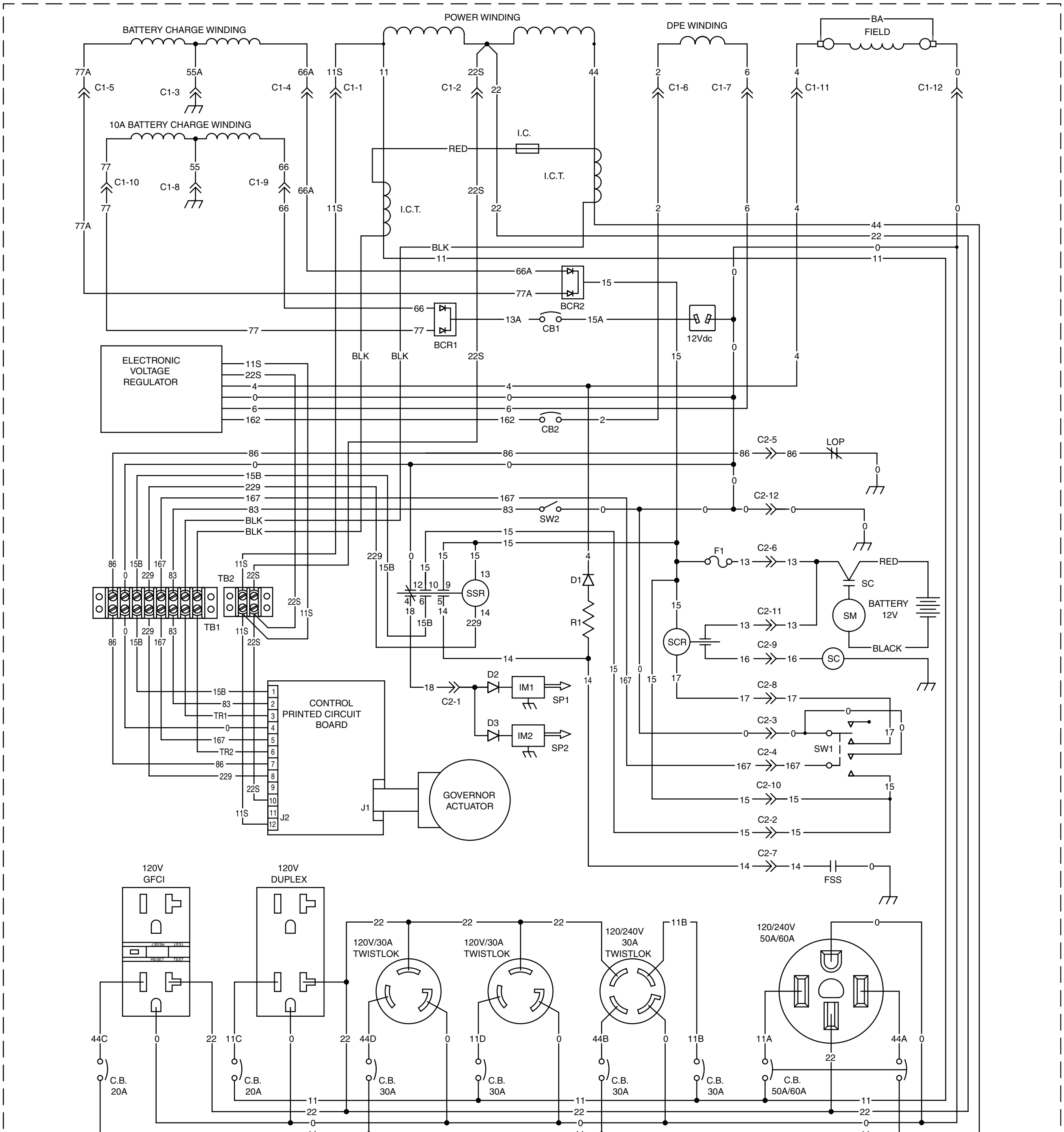
## Wiring Diagram 17.5 kW – Drawing No. 0G0731






LEGEND
BA - BRUSH ASSEMBLY
CB1 - 6AMP AUTO RESET BREAKER
D - ENGINE SHUTDOWN DIODE
D2 - 600V 12A DIODE
F1 - 10A FUSE
FSS - FUEL SHUT OFF SOLENOID
GND - GROUND BAR
IM1 - IGNITION MODULE, CYL. 1
IM2 - IGNITION MODULE, CYL. 2
LOP - LOW OIL PRESSURE
R1 - 25 OHM, 25W RESISTOR
SC - STARTER CONTACTOR
SCR - STARTER CONTACTOR RELAY
SM - STARTER MOTOR
SP1 - SPARK PLUG, CYL. 1
SP2 - SPARK PLUG, CYL. 2
SSR - START / STOP RELAY
TB1, TB2 - TERMINAL BLOCK

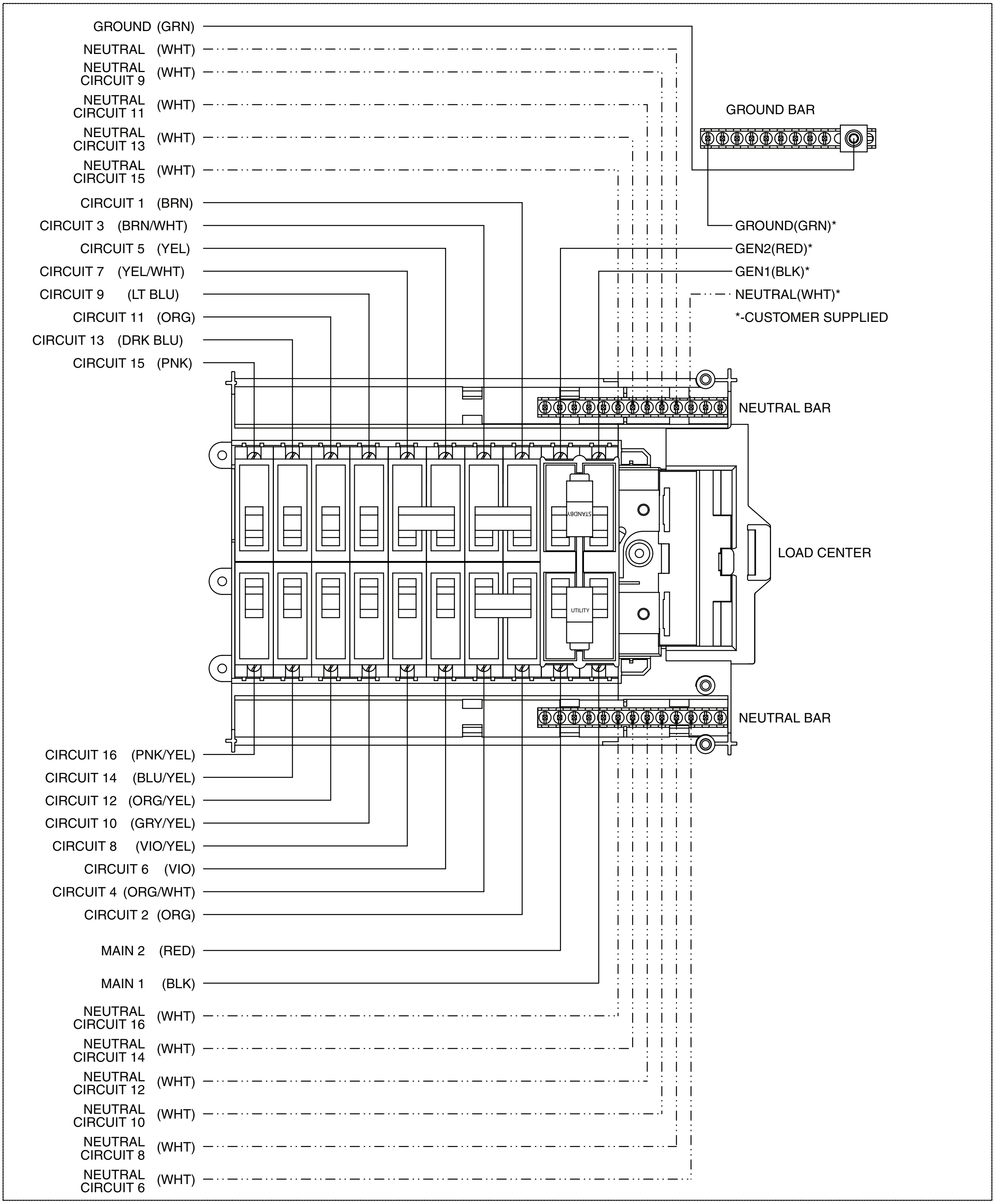
## Electrical Schematic 17.5 kW – Drawing No. 0G0733



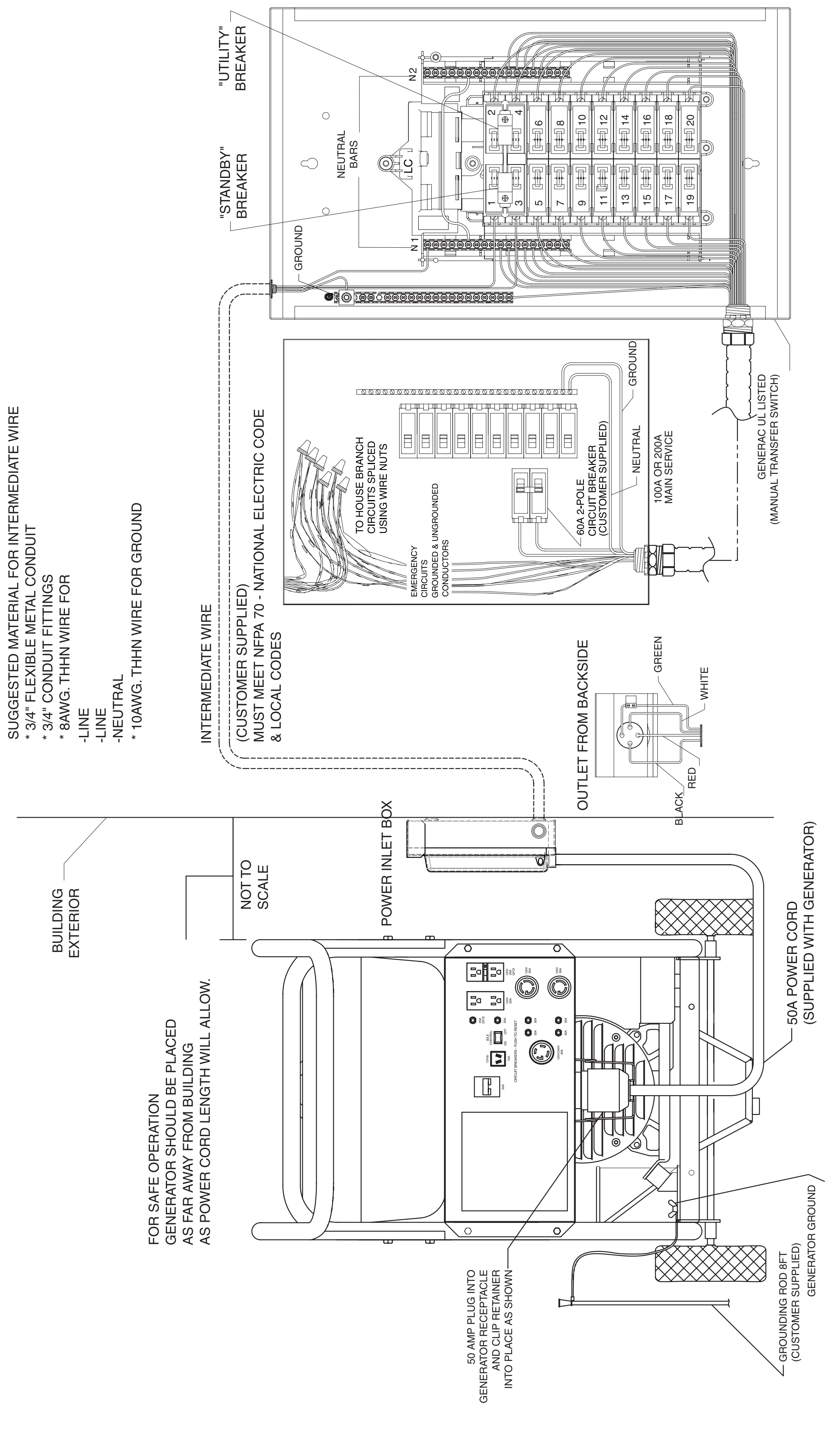

LEGEND

BA - BRUSH ASSEMBLY
BCR1 - BATTERY CHARGE RECTIFIER, 10A
BCR2 - BATTERY CHARGE RECTIFIER
CB1 - 10AMP AUTO RESET BREAKER
CB2 - 6AMP AUTO RESET BREAKER
D1 - 600V 12A DIODE
D2, D3 - ENGINE SHUTDOWN DIODE
F1 - 10A FUSE
FSS - FUEL SHUT OFF SOLENOID
GND - GROUND BAR
I.C.T. - IDLE CONTROL TRANSFORMER
IM1 - IGNITION MODULE, CYL. 1
IM2 - IGNITION MODULE, CYL. 2
LOP - LOW OIL PRESSURE
R1 - 25 OHM, 25W RESISTOR
SC - STARTER CONTACTOR
SCR - STARTER CONTACTOR RELAY
SM - STARTER MOTOR
SP1 - SPARK PLUG, CYL. 1
SP2 - SPARK PLUG, CYL. 2
SSR - START / STOP RELAY
SW1 - START-RUN-STOP RELAY
SW2 - IDLE CONTROL SWITCH
TB1, TB2 - TERMINAL BLOCK

**Wiring Diagram, 17.5 kW Manual Transfer Switch – Drawing No. 0G1065**



**INTERCONNECTION DRAWING – 17.5 KW GENERATOR CONNECTED TO THE EXTERNAL CONNECTION BOX, MANUAL TRANSFER SWITCH AND HOME'S MAIN ELECTRICAL DISTRIBUTION PANEL**



| GENERATOR SPECIFICATIONS | | | |
|---|---|---|---|
| **MODEL** | **GPS 12500** | **GPS 15000** | **GPS 17500** |
| Model # | 004451<br>004986 | 004582<br>004987<br>005209 | 004583<br>005308 |
| Rated Max. Power | 12.5 kW | 15.0 kW | 17.5 kW |
| Surge Power | 18.75 kW | 22.5 kW | 26.25 kW |
| Rated AC Voltage | 120/240 | 120/240 | 120/240 |
| Rated Max AC Load | | | |
| Current @ 240V | 52.0 Amps | 62.5 Amps | 72.9 Amps |
| Current @ 120V | 104.0 Amps | 125.0 Amps | 145.8 Amps |
| Rated Frequency | 60 Hz @ 3600 RPM | | |
| Phase | Single Phase | | |
| Rated DC Voltage | 12 Volts | | |
| Rated Max DC Load Current @ 12 Volts | 10 Amperes | | |
| ***ENGINE SPECIFICATIONS*** | | | |
| Rated Horsepower @3600 RPM | 27 | 30 | 33 |
| Displacement | 763cc | 992cc | 992cc |
| Spark Plug Type | Champion RC14YC or Equivalent | | |
| Spark Plug Gap | 0.040 inch or (1.01 mm) | | |
| Gasoline Capacity | 16 U.S. gallons | | |
| Oil Type | Summer – SAE 30 or 10W-30<br>Winter – Synthetic 5W-20 or 5W-30 | | |
| Oil Capacity | w/ Filter Change = 1.7 Qts. w/o Filter Change = 1.4 Qts. | | |
| Run Time/Fuel Consumption-1/2 Load | 10 Hours / 1.6 gallons per hour | | |

***ENGINE SPEEDS AND VOLTAGE SPECIFICATIONS***

Listed below are normal running voltages, load voltages and frequency ranges.

| LOAD % | VOLTAGE (VAC) | FREQUENCY (HZ) |
|---|---|---|
| 0 | 238-242 | 59-61 |
| 50 | 238-242 | 59-61 |
| 100 | 238-242 | 59-61 |

Refer to Engine Service Manual No. 0F6923 for complete GTV-760/990 V-Twin OHVI engine service information.

## *TORQUE SPECIFICATIONS*

| | |
|---|---|
| Flywheel Nut | 150 ft. lbs. |
| Cylinder Head Bolts | 22 ft. lbs. |
| Valve Cover Bolts | 4.8-5.5 ft. lbs. |
| Rocker Arm Jam Nut | 14 ft. lbs. |
| Ignition Coil | 9 ft. lbs. |
| Intake Manifold | 14 ft. lbs. |
| Exhaust Manifold | 14 ft. lbs. |
| Stator Bolt | 12 ft. lbs. |
| Rotor Bolt | 30 ft. lbs. |
| Spark Plug | 15 ft. lbs. |
| Starter Bracket To Block | 18 ft. lbs. |

## *TRIM TORQUE SPECIFICATIONS*

| | |
|---|---|
| M3-.5 PHILLIPS PAN HEAD SCREW INTO ALUMINUM | 50 in. lbs. |
| M6-1 TAPTITE SCREW INTO ALUMINUM 9 | 6in. lbs. |
| M6-1 TAPTITE SCREW INTO WELDNUT | 96 in. lbs. |
| M8-1.25 TAPTITE SCREW INTO ALUMINUM | 18 ft. lbs. |

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