FLIGHT SYSTEMS

G-MAN

GENERATOR MAN ®

RV GEN SET SERVICE TOOL

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OPERATORS MANUAL

FLIGHT SYSTEMS

207 Hempt Road Mechanicsburg, PA 17050 USA

717-590-7330 Fax: 717-590-7327

www.flightsystems.com

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NOTES:

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INTRODUCTION

The G-MAN is designed with the RV generator service technician in mind. This versatile service tool speeds the troubleshooting process by eliminating guesswork and pinpointing problems. Troubleshooting is broken down into the four specific areas of the ENGINE, ENGINE CONTROL, GENERATOR and REGULATOR. Until now, generator control troubleshooting was complicated by the normal action of the control to prevent starting or cause a shutdown in the event of a problem. This can be a "dead end" that prevents the troubleshooting process from moving forward without guesswork, jumper wires and/or parts substitution. This approach can be both time-consuming and expensive.

What makes the G-MAN unique is its ability to plug in to the generator's control system and become a part of it, instead of being a circuit board or component tester. You can run the engine without the control board because the G-MAN takes over many of its functions. If operation is normal with the G-MAN but not with the control board plugged in, then you know right away that you have a bad control board. If any of the signals to the control board are missing, the G-MAN will tell you. In like manner, certain tests are performed with the regulator disconnected. This is called testing by exception and is a better method than mere parts substitution. Parts substitution can lead to additional problems or damage and is often inconclusive because the trouble lies elsewhere. Substitution is still useful as part of an organized troubleshooting system.

Another unique feature of the G-MAN is its on-board megger capability. With this feature, all generator windings can be easily checked for grounds or winding-to-winding leakage at 200 VDC. The calibrated leakage indicator comes on if the leakage resistance is less than one Meg Ohm. This test is more realistic than ohmmeter readings alone and can spot high voltage insulation breakdown that may not show up on a meter. The megger can also be used to test other components such as diodes, zeners, suppressors, transformers, capacitors and more.

With its 9 status indicators and 16 test jacks, the service technician has a visual "picture" of the system status at all times, as well as a convenient means of access to all key points for making resistance and voltage measurements. This nearly eliminates the need to disconnect wires or probe connectors to make measurements. Through the use of adapters, virtually all of the various Onan RV generator models are covered by one tool housed in a rugged carrying case. The G-MAN includes all test harnesses, an adapter "starter kit" (for 300-3056, 300-3687, 300-3950, 300-3763 and 300-5268 control boards), 2 patch cords, 2 alligator clips, a quick reference card and complete operating instructions. See *Accessories* for additional adapters.

In the instructions that follow, test procedures and troubleshooting techniques are given that are applicable to a number of models of Onan RV generators. Information is generalized whenever possible to save space. Differences between generator models and their controls will be pointed out where they materially affect readings, indications and testing procedures.

In compiling this manual, we have used several sources of information, which have been cross-checked and are believed to be accurate. If errors or omissions are found, please bring them to our attention so that they can be promptly resolved. We would also appreciate any suggestions you may have to make this manual more useful. Thank you for your help.

RATINGS AND SAFETY PRECAUTIONS

PLEASE READ and UNDERSTAND BEFORE USING THIS TOOL

The G-MAN service tool is designed for use by generator service professionals and others who are familiar with engine-generator sets and their controls. Working on engines, generators and their controls presents certain hazards to equipment and personnel. It is assumed that the G-MAN user is adequately trained in the proper use of test equipment and the management of risks inherent in generator servicing. The G-MAN is not intended for use by the general public. Flight Systems is not responsible for damage to equipment or injury to personnel, either direct or consequential, arising from the use of the G-MAN service tool. Liability is limited to repair or replacement of defective product under the terms of the standard warranty.

Certain tests are performed using a digital multi-meter (DMM) such as a Fluke, or a volt-ohmmeter (VOM) such as a Simpson 260, used alone or in conjunction with the G-MAN. It is assumed that the service person is familiar with the proper use of these instruments so as to avoid damage and ensure personal safety. Procedures given in this manual will generally not specify function and range settings for meters.

This service tool is designed for use ONLY on 120 volt, 50 or 60 Hz, single-phase generators using a 12-volt electrical system.

CAUTION: Always use the correct adapter for each control board. Some adapters look similar and have identical connectors, but a different pin assignment. Do not assume that just because an adapter plugs in, it will work! Improper connections can cause damage to the generator controls and/or to the G-MAN. Such damage is not covered by the warranty.

Do not continue to use the G-MAN if it is damaged, or test harnesses or adapters if they are broken, worn, cut, frayed, corroded, etc. Send them to Flight Systems for repair. Replacements are available at a reasonable cost in the event they are not repairable.

AVOID A SHOCK HAZARD. Do not use this tool in wet locations or outdoors during precipitation. If the tool becomes wet, make sure it has thoroughly dried before connecting it to energized circuits.

CAUTION – HAZARDOUS VOLTAGE: The nine generator/regulator test jacks (MAIN, AUX, BAT, FIELD and CAPACITOR can have peak voltages of over 200 volts on them when the generator and regulator harnesses are connected and the generator is running. These same test jacks can have 200 VDC on them when leakage and component tests are performed *without* the generator running. All of the other test jacks have only low voltage and are not hazardous. The metal panel of the tool is floating and not grounded. The plastic face is non-conducting.

Some diagnostic tests are performed using the supplied red and black patch cords and insulated alligator clips to connect a meter or a generator winding, to test components or to connect two test jacks together. When performing these tests, use EXTREME CAUTION and follow the

procedure exactly. Disconnect all patch cords as soon as a test is completed. Do not allow patch cord ends to hang free. This is an accident waiting to happen.

The START button is enabled as soon as 12 VDC power is connected and the 12 VDC POWER light comes on. During a normal engine start, cranking is automatically terminated and locked out when the RUN RELAY light comes on. If for any reason the RUN RELAY light does not come on, the starter is not locked out. In this event, the starter will stay engaged if the START button is held, or will try to re-engage if the START button is pressed, after the engine is running. This can damage the starter and/or the flywheel gear.

On LP-fueled gensets, the flow of gas to the throttle body is controlled by the fuel solenoid, which is energized by the ignition/fuel output of the engine control board. When the G-MAN takes over this function, it is possible to energize the ignition/fuel circuit *without* the engine running. To avoid the possibility of a hazardous condition of LP gas build-up, DO NOT leave the IGNITION/FUEL switch on for more than 20 seconds at a time without starting the engine. If the engine does not start after a few cranks, turn the IGNITION/FUEL switch off and allow any LP gas fumes that may have built up to dissipate before the next start attempt.

The red 12 VDC POWER test jack is protected with a series resistor and can be shorted to ground without damage. It is intended for voltage measurement only. The G-MAN cannot be powered from this jack nor can power be supplied from it.

TEST STRATEGY

Perform the ENGINE routine tests to verify that the engine, battery and fuel system are in good running condition. The electronic governor on engines so equipped must be functioning properly. Correct any deficiencies.

Perform the ENGINE CONTROL tests to verify proper operation with G-MAN simulation of the control and to determine by exception if the control board is faulty. Correct any deficiencies and/or replace the control board if faulty.

Perform the GENERATOR tests to verify proper resistance values, leakage to ground, leakage from winding to winding and output voltages. CAUTION: A low field resistance reading may result in regulator failure. An excessively high field resistance will result in low output voltage and is indicative of brush and/or slip ring problems. Correct any deficiencies. If resistance readings are normal but generator output voltages are low, proceed to *Regulator Tests*.

Perform the REGULATOR tests to verify proper operation of the regulator for field flash and voltage regulation. A spare regulator is convenient for testing. If the regulator is suspected, perform G-MAN simulation of the regulator to determine by exception if the regulator is faulty. The generator will produce about 40% of rated voltage during this test. This is enough voltage to determine if the problem is in the generator or the regulator. Replace the regulator if faulty.

ENGINE TESTS

Before any evaluation of the controls, regulator or generator can be made, the Onan engine must have oil and fuel, be in running condition and the 12-volt battery charged. The electronic governor on engines so equipped must be functioning properly. IMPORTANT: Change the G-MAN 5A SB fuse to 10A STD for electronic governors only. This manual does not cover engine maintenance and repair procedures (please refer to the applicable Onan Service Manual for this information). However, the G-MAN can make routine engine tests more convenient by directly controlling fuel, ignition and cranking *independent* of the engine's controls. For routine engine tests, proceed as follows:

1. IMPORTANT: Check engine oil level *before* starting. For diagnostic purposes, the G-MAN allows the engine to start and run *without* oil or oil pressure except on models where the oil level switch is hard-wired to the magneto (KV, KVC and KVD). On these models, it may be necessary to disconnect the oil level switch if it is stuck and not opening.

2. Remove panel or cover to gain access to the control board or module. Some disassembly may be required. The exact procedure depends on the model.

3. Unplug the control board and connect the G-MAN CONTROL harness to the RV's engine control harness using the proper adapter (See APPLICATION CHART). On engines equipped with an electronic governor, an additional plug on the control harness adapter (56-A360-3764) plugs in to the governor in order to gain control of the oil pressure switch. It is generally not necessary to connect the GENERATOR or REGULATOR harnesses for basic engine troubleshooting. The G-MAN does not connect to the remote harness. As soon as the G-MAN has 12-volt power, the 12VDC POWER indicator will come on. The LOL/LOP SWITCH indicator may also come on, depending on the model.

4. Connect the negative voltmeter lead to the GROUND jack and the positive lead to the 12 VDC POWER jack on the G-MAN and read the battery voltage. A fully charged battery in good condition should read 12.6 to 12.8 VDC. Charge the battery if necessary.

5. If desired, check the pressure and flow of the fuel pump by temporarily disconnecting the fuel line to the carburetor and controlling the fuel pump with the IGNITION/FUEL switch on the G-MAN. The IGNITION/FUEL switch also operates the fuel solenoid on LP models. Note: If the generator has not been run for several months, the carburetor float may be stuck open or closed and /or the jets and needle valves may be gummed up by old fuel that has turned to varnish. The automatic choke may be stuck closed or binding so that it does not open as the choke heater warms up. These conditions will prevent the engine from starting or running smoothly and must be corrected before proceeding.

6. Check the starter by momentarily pressing the START button on the G-MAN with the IGNITION/FUEL switch off. NOTE: The Emerald series (Spec. A-F) will attempt to start during this test unless the wire feeding diode D9 is disconnected at the start r solenoid. Pulling off the front spark plug wire will not prevent starting. The engine should crank normally and turn freely. The battery voltage should not go below 9.5 VDC during cranking.

7. If desired, check the ignition by removing the front spark plug (or only spark plug) and then reconnect it so that the plug is grounded and the gap is visible. Crank the engine with the IGNITION/FUEL switch on and watch for proper spark. Twin cylinder engines may try to start even with one spark plug removed. Turn IGNITION switch off to stop the engine.

8. If desired, check engine compression using the START button, provided that both of the spark plug holes are accessible for attaching the compression gauge (the front one is usually accessible). On some models, it is necessary to remove the generator from the coach to perform this test.

Common Problems: (caused mainly by lack of use and/or lack of regular monthly exercise).

- Low battery voltage because of insufficient charge, worn out battery, faulty cables or poor connections, resulting in slow cranking and hard starting.
- Old or contaminated fuel that has turned to varnish in the lines, fuel filter and carburetor (this can cause clogged jets and/or a stuck carburetor float resulting in improper fuel/air mixture).
- Weak spark and/or fouled spark plug(s) causing hard starting and rough running.
- Stuck automatic choke causing an excessively rich mixture and smoking.
- Stuck oil pressure switch causing shutdown as soon as the start button is released.
- Dirty air filter causing an excessively rich mixture and smoking.
- Low compression because of "high time", broken rings, burned or stuck valves or other engine damage.

ENGINE CONTROL TESTS

Summary of Engine Control Board Features

The engine control board or module controls the ignition, fuel pump, fuel solenoid, field flash and starter. On LP models, it controls the flow of LP gas to the throttle body. Some control boards incorporate a battery charging circuit, while others have an external battery charging circuit. All models monitor either oil level or oil pressure and prevent the engine from starting or running if there is insufficient oil or oil pressure. Models equipped with electronic governors can shut the engine down on low oil pressure by sending a signal to the control board. Additionally, most models require a voltage from the generator to keep the engine running once it has started. Most controls have three relays (300-2943 has four). One of these, called the "run" relay (K3), energizes when the engine starts, remains energized when the engine is running and supplies power to the ignition and fuel circuits. All controls terminate cranking and lock out the starter after the engine has started. The controller used on Models KY (Spec. J) and KYD (Spec. A) is microprocessor-based and combines the functions of the engine control and regulator in one module.

How the G-MAN Works

The G-MAN simplifies troubleshooting by allowing the engine to be started and run *without* the control board. It does this by taking over most of the functions of the control board, including the action of the run relay. The generated voltage does not have to be present for the engine to run. Also, the oil level or oil pressure switch is by-passed (except for KV, KVC and KVD

models where the level switch is hard wired to the magneto ignition). Status indicators and voltage test jacks are provided for all functions. The status indicators provide information at a glance without the need to connect additional test equipment. The response of certain status indicators on the G-MAN will depend on the control board part number used on a particular generator model and how it is connected to the other components of the system. For example, the LOL/LOP SWITCH indicator will be *on* for good status on some models, and *off* for good status on others. Not all of the indicators are used for each control board. Accordingly, *specific instructions* and test procedures are given below for each control board part number. Engine control-related G-MAN features include:

- 12 VDC power status and voltage test jack
- Starter control with automatic crank terminate and lockout
- Ignition / fuel pump / fuel solenoid control
- Field flash control (automatic and manual)
- Field Flash status and voltage test jack
- LOL / LOP switch status and voltage test jack (except KV, KVC and KVD)
- Run relay status
- Battery charging volts test jack (when applicable)
- LP Shutdown status and voltage test jack (when applicable)
- L1 AC Volts status and voltage test jack (when applicable)
- Ground test jack for measurements

NOTE: The above features are concerned only with the engine control board or module. Other features not mentioned here will be covered in detail in the *Generator* and *Regulator* sections of this manual.

Control Board Adapters

The G-MAN connects directly to the RV's engine control and regulator harnesses. Since different control boards have different connectors and pin assignments, adapters are used on the end of the G-MAN's CONTROL harness. For models equipped with an electronic governor, the adapter (56-A360-3764) also connects to the governor harness. Generally, each control board part number has a corresponding adapter, although certain control boards use the same adapter. See APPLICATION CHART. The G-MAN is shipped with an adapter "starter kit" for 300-3056 and 300-3763 style control boards. At present, the G-man can adapt to 23 control board part numbers used on various Onan generator models. The adapters for control modules 327-1413 and 300-5374 work with a standard regulator for test. The 300-5002 control module and 305-0911 regulator require a set of 3 adapters. Look on the control board or module to determine the part number or refer to the APPLICATION CHART. The instructions below will call out the proper control board or regulator adapter for each application.

Procedures by Control Board Part Number

To prevent possible damage to external circuits or appliances, MAKE SURE that the AC CIRCUIT BREAKER IS OFF during control and generator testing.

Control Boards 300-2943 and 300-2784

1. Connect the adapter 56-A360-2784 to the G-MAN CONTROL harness.

2. Remove the screws. Disconnect the control board and remove the panel.

3. Disconnect the remote harness plug P2.

4. Connect the adapter to the engine control harness the same way as the control board was connected. The 12 VDC POWER indicator comes on. If not, check for battery voltage at the BAT. terminal on the starter solenoid and P1-6. Make sure there is no voltage at the GROUND test jack (P1-8) with respect to the frame.

5. The GENERATOR and REGULATOR harnesses are not connected, as this model uses a transformer-type regulator instead of an electronic regulator. The G-MAN does not have access to the generator windings or the regulator. Its use is limited to engine control only.

6. Connect the DMM negative lead to the GROUND test jack and the positive lead to the 12 VDC POWER test jack. A fully charged battery in good condition should read 12.6 to 12.8 VDC. Charge the battery if necessary.

7. Turn on the IGNITION/FUEL switch. The fuel pump should be heard working. If not, check wiring from P1-3 and the fuel pump. Apply 12 volts directly to the pump if necessary. The remote run light is powered from the fuel pump circuit for this test.

8. Press the START button and the engine cranks. If not, check wiring from P1-2 and the start solenoid. The battery voltage should not fall below 9.5 VDC during cranking. If so, check the battery condition and cables. The IGNITION/FUEL switch is used to stop the engine.

9. Field flash is energized automatically during cranking and until generator voltage builds. The field flash can also be tested manually at any time by pressing the FIELD FLASH button. The field flash voltage is not available at the FIELD FLASH test jack and the FIELD FLASH indicator does not light on this model. The field flash voltage is available at the (+) terminal of rectifier bridge CR4. It should be 11 VDC, minimum. If not, check wiring from P1-5.

10. After the engine starts and oil pressure builds, the LOL/LOP SWITCH indicator will come on indicating that the oil pressure switch has closed to ground. A voltage near zero at the LOL/LOP SWITCH test jack means that the switch is closed. If the LOL/LOP SWITCH indicator does not come on, the cause is likely a stuck switch. Starting the engine several times, or tapping on the switch can sometimes cure this. A broken wire from the switch to P1-4 can also be the cause. The oil pressure switch is used by the G-MAN to pull in the run relay since the B1-B2 voltage cannot be used for this purpose (because B2 is grounded).

11. After the engine starts, the RUN RLY indicator comes on. This indicates that the oil pressure switch has pulled in the run relay in the G-MAN (B1-B2 voltage is normally used). If the

RUN RELAY indicator does not come on, there may be a problem with the oil pressure switch. See above.

12. The FIELD VOLTS indicator will not be on, because it is not connected to the field.

13. The STATOR AC VOLTS indicator will not be on, because it is not connected to the main stator.

14. Measure the battery charging voltage at the BAT. CHG. VOLTS test jack. It should be approximately 12 VDC. NOTE: This voltage is not coming from stator B1-B2, as it is not accessible. Measure the B1-B2 voltage at the BAT. CHG. RESISTOR test jack. It should be 18-26 VAC. If not, check the wiring from P1-1.

15. With the engine stopped, measure the battery-charging resistor by connecting the DMM (set to lowest ohms range) positive lead to the BAT. CHG. RESISTOR test jack and the negative lead to the generator frame. Do not use the GROUND test jack as this will result in an erroneous reading. The resistance reading should be 2.3 to 3.0 ohms or 5.0 to 6.0 ohms, depending on the model. If not, check the battery-charging resistor, ground connection and wiring. Note: The resistor is being read *through* the B1-B2 stator winding to ground.

16. If all of the above tests are satisfactory, the engine should be run with the control board in place and the battery charging function checked (if equipped) by noting the rise in battery voltage with the generator running.

Operation of LP models (BGEL, NHEL) is the same, with a few exceptions. There is no fuel pump and a solenoid valve controls the flow of LP gas. For added safety, ignition relay (K5) grounds the stop circuit if voltage to the ignition coil is lost. Before starting, the LP SHUTDOWN indicator will be on, showing that K5 is grounding the stop circuit. This indicator should go off as soon as the ignition circuit and K5 become energized.

Control Boards 300-3056, 300-3687, 300-3950, 300-3763 and 300-

1. Connect the adapter 56-A360-3056 or 56-A360-3763, as appropriate, to the G-MAN CONTROL harness. NOTE: Pin references in brackets [ ] apply to 300-3763 and 300-5268.

2. Disconnect the remote harness at the right side of the control panel.

3. Remove the two T25 screws. Disconnect the control board and remove the panel.

4. Disconnect the regulator and plug the G-MAN's GENERATOR harness into the plug just removed from the regulator.

5. Plug the G-MAN's REGULATOR harness into the regulator (or a known good regulator).

6. Connect the adapter to the engine control harness the same way as the control board was connected. See Illustration. CAUTION: The 6-position and 8-position connectors for the

300-3056 and 300-3687 control boards must be connected properly. The 12 VDC POWER indicator comes on. If not, check for battery voltage at the BAT. terminal on the starter solenoid and P1-6 [P1-7]. Make sure there is no voltage at the GROUND test jack (P1-8) [P1-11] with respect to the frame.

7. Connect the DMM negative lead to the GROUND test jack and the positive lead to the 12 VDC POWER test jack. A fully charged battery in good condition should read 12.6 to 12.8 VDC. Charge the battery if necessary.

8. Turn on the IGNITION/FUEL switch. The fuel pump should be heard working. If not, check R7, a 1.5 ohm resistor in series with the fuel pump (300-3056, 3687 only), wiring from P3-6 [P1-12] and the fuel pump. Apply 12 volts directly to the pump if necessary.

9. Press the START button and the engine cranks. If not, check the wiring from P1-2 [P1-9] and the start solenoid. The battery voltage should not fall below 9.5 VDC during cranking. If so, check the battery condition and cables. The IGNITION/FUEL switch is used to stop the engine.

10. During cranking, the FIELD FLASH indicator will be on. Field flash is energized automatically during cranking and until generator voltage builds. The field flash can also be tested manually at any time by pressing the FIELD FLASH button. Measure the field flash voltage at the FIELD FLASH test jack. It should be 11 VDC, minimum. If not, check wiring between P1-5 [P1-1] and regulator plug pin 7.

11. After the engine starts, the FIELD FLASH indicator goes off and the RUN RLY indicator comes on. This indicates that the run relay in the G-MAN has pulled in and that the starter is locked out. It also indicates that the B1-B2 stator (P1-1, P1-7) [P1-2, P1-4] is producing voltage. If the RUN RELAY indicator does not come on, there may be a problem with the generator or regulator. In this case, proceed to the *Generator* and/or *Regulator* section.

12. As soon as oil pressure builds, the LOL/LOP SWITCH indicator will come on indicating that the oil pressure switch has closed to ground. A voltage near zero at the LOL/LOP SWITCH test jack means that the switch is closed. If the LOL/LOP SWITCH indicator does not come on, the cause is likely a stuck switch. Starting the engine several times, or tapping on the switch can sometimes cure this. A broken wire from the switch to P3-4 [P1-5] can also be the cause.

13. The FIELD VOLTS indicator should be on, indicating that the regulator is producing at least 40 VDC (minimum field). If not, proceed to the *Generator* and/or *Regulator* section.

14. The STATOR AC VOLTS indicator should be on, indicating that the main stator is producing at least minimum voltage. If not, proceed to the *Generator* and/or *Regulator* section.

15. Measure the battery charging voltage at the BAT. CHG. VOLTS test jack. It should be 18 to 20 VDC. If not, proceed to the *Generator* and/or *Regulator* section.

16. Measure the battery-charging resistor by connecting the DMM (set to lowest ohms range) positive lead to the BAT. CHG. RESISTOR test jack and the negative lead to the generator frame. Do not use the GROUND test jack as this will result in an erroneous reading. The resistance reading should be 2.3 to 3.0 ohms or 5.0 to 6.0 ohms, depending on the model. If not, check the battery charging resistor, ground connection and wiring to P1-4 [P1-3].

17. If all of the above tests are satisfactory, the engine should be run with the control board in place and the battery charging function checked (if equipped) by noting the rise in battery voltage with the generator running.

Operation of LP models (BGEL, NHEL) is the same, with a few exceptions. There is no fuel pump and a solenoid valve controls the flow of LP gas. For added safety, ignition relay (K5) grounds the stop circuit if voltage to the ignition coil is lost. Before starting, the LP SHUTDOWN indicator will be on, showing that K5 is grounding the stop circuit. This indicator should go off as soon as the ignition circuit and K5 become energized.

Control Boards 300-3764, 300-5342, 300-4902 and 300-5276

To supply the extra current required by the electronic governor, change the G-MAN fuse to a standard 10 A fuse. For all other control boards, use the 5 A Slo-Blo fuse supplied.

1. Connect the adapter 56-A360-3764 to the G-MAN CONTROL harness.

2. Disconnect the remote harness at the right side of the control panel (except 4902, 5276).

3. Remove the two T25 screws. Disconnect the control board and remove the panel.

4. Disconnect the regulator and plug the G-MAN's GENERATOR harness into the plug just removed from the regulator.

5. Plug the G-MAN's REGULATOR harness into the regulator (or a known good regulator).

6. Disconnect the 2-position governor connector J3 (gray with orange end). Leave J5 and J6 connected.

7. Re-connect the governor connector J3 to its harness with the adapter in between. This allows the G-MAN access to the oil pressure switch and to satisfy the governor oil pressure input.

8. Connect the adapter to the engine control harness the same way as the control board was connected. The 12 VDC POWER and LOL/LOP SWITCH indicators come on. If not, check for battery voltage at the BAT. terminal of the starter solenoid and P1-7. Make sure there is no voltage at the GROUND test jack (P1-1) with respect to the frame.

9. Connect the DMM negative lead to the GROUND test jack and the positive lead to the 12 VDC POWER test jack. A fully charged battery in good condition should read 12.6 to 12.8 VDC. Charge the battery if necessary.

10. Turn on the IGNITION/FUEL switch. The fuel pump should be heard working. If not, check the wiring from P1-4, and the fuel pump. Apply 12 VDC directly to the pump if necessary.

11. Press the START button and the engine cranks. If not, check the wiring from P1-2 and the start solenoid. The battery voltage should not fall below 9.5 VDC during cranking. If so, check the battery condition and cables. The IGNITION/FUEL switch is used to stop the engine.

12. During cranking, the FIELD FLASH indicator will be on. Field flash is energized automatically during cranking and until generator voltage builds. The field flash can also be tested manually at any time by pressing the FIELD FLASH button. Measure the field flash voltage at the FIELD FLASH test jack. It should be 11 VDC, minimum. If not, check the wiring between P1-3 and regulator pin 7.

13. After the engine starts, the FIELD FLASH indicator goes off and the RUN RLY indicator comes on. This indicates that the governor output on J6-B connected to P1-5 has pulled in the run relay in the G-MAN and that the starter is locked out.

14. As soon as oil pressure builds, the LOL/LOP SWITCH indicator will go off indicating that the oil pressure switch has opened. A voltage near zero at the LOL/LOP SWITCH test jack means that the switch has not opened or the wire (J3-2) is shorted to ground.

15. The FIELD VOLTS indicator should be on, indicating that the regulator is producing at least 40 VDC (minimum field). If not, proceed to the *Generator* and/or *Regulator* section.

16. The STATOR AC VOLTS indicator should be on, indicating that the main stator is producing at least minimum voltage. If not, proceed to the *Generator* and/or *Regulator* section.

17. The voltage at the BAT. CHG. VOLTS test jack should be approximately 12 VDC. This is not the real battery charging voltage. The rise in battery voltage can be checked at the 12 VDC POWER test jack. The battery-charging resistor is not accessible from the G-MAN on this model. It can be measured between ground and the CR10 (-) terminal.

18. If all of the above tests are satisfactory, the engine should be run with the control board in place and the battery charging function checked (if equipped) by noting the rise in battery voltage with the generator running.

Operation of LP models (BGEL, NHEL) is the same, with a few exceptions. There is no fuel pump and a solenoid valve controls the flow of LP gas. For added safety, ignition relay (K5) grounds the stop circuit if voltage to the ignition coil is lost. Before starting, the LP SHUTDOWN indicator will be on, showing that K5 is grounding the stop circuit. This indicator should go off as soon as the ignition circuit and K5 become energized.

Control Boards 300-4155, 300-3797

1. Connect the adapter 56-A360-4155 to the G-MAN CONTROL harness.

2. Disconnect the battery negative cable. Remove the access cover. The control module and starter solenoid is fastened to a bracket in the lower left corner of the enclosure base. Unfasten the starter solenoid and move it out of the way to gain access to the control module.

3. Disconnect the 15-position plug at the control module. It is not necessary to disconnect the 6-position plug unless the module is being replaced.

4. Connect the adapter to the engine control harness just removed from the control module.

5. Disconnect the regulator and plug the G-MAN's GENERATOR harness into the plug just removed from the regulator.

6. Plug the G-MAN's REGULATOR harness into the regulator (or a known good regulator).

7. Re-install the starter solenoid making sure all connections are secure. Re-connect the battery negative cable. The 12 VDC POWER indicator comes on. If not, check for battery voltage at the BAT. terminal of the starter solenoid and J1-10. Make sure there is no voltage at the GROUND test jack (J1-4) with respect to the frame. The LOL/LOP SWITCH indicator should not be on. If it is, check the oil level before starting. A voltage near zero at the LOL/LOP SWITCH test jack means that the switch is closed (low oil level) or the wire (J1-7) is shorted to ground.

8. Connect the DMM negative lead to the GROUND test jack and the positive lead to the 12 VDC POWER test jack. A fully charged battery in good condition should read 12.6 to 12.8 VDC. Charge the battery if necessary.

9. Turn on the IGNITION/FUEL switch. The fuel pump should be heard working. If not, check the wiring from J1-12, and the fuel pump. Apply 12 VDC directly to the pump if necessary.

10. Press the START button and the engine cranks. If not, check the wiring from J1-8, and the start solenoid. The battery voltage should not fall below 9.5 VDC during cranking. If so, check the battery condition and cables. The IGNITION/FUEL switch is used to stop the engine.

11. During cranking, the FIELD FLASH indicator will be on. Field flash is energized automatically during cranking and until generator voltage builds. The field flash can also be tested manually at any time by pressing the FIELD FLASH button. Measure the field flash voltage at the FIELD FLASH test jack. It should be 11 VDC, minimum. If not, check the wiring between J1-5 and regulator pin 7.

12. After the engine starts, the FIELD FLASH indicator goes off and the RUN RLY indicator comes on. This indicates that the B1-B2 voltage (J1-9, J1-11) has pulled in the run relay in the G-MAN and that the starter is locked out.

13. Measure the battery charging voltage at the BAT. CHG. VOLTS test jack. It should be 18 to 20 VDC.

14. The FIELD VOLTS indicator should be on, indicating that the regulator is producing at least 40 VDC (minimum field). If not, proceed to the *Generator* and/or *Regulator* section.

15. The STATOR AC VOLTS indicator should be on, indicating that the main stator is producing at least minimum voltage. If not, proceed to the Generator and/or Regulator section.

16. If all of the above tests are satisfactory, the engine should be run with the control board in place and the battery charging function checked (if equipped) by noting the rise in battery voltage with the generator running.

Operation of an LP model is the same with a few exceptions. There is no fuel pump and a solenoid valve controls the flow of LP gas. On models equipped with LP shutoff, a closed switch (to ground) on this circuit will prevent starting or will shut down the engine if it is running. The LP SHUTOFF indicator on the G-MAN will be on if this switch is closed.

Control Boards 300-4320, 300-4923

1. Connect the adapter 56-A360-4320 to the G-MAN CONTROL harness.

2. Disconnect the battery negative cable. Remove the access cover. The control module and regulator are fastened to a bracket in the lower left corner of the enclosure base. Unfasten the starter solenoid and move it out of the way to gain access to the regulator and control module. Unfasten the regulator if necessary to reach the control module plug.

3. Disconnect the 15-position plug at the control module. It is not necessary to disconnect the 6-position plug unless the module is being replaced.

4. Connect the adapter to the engine control harness just removed from the control module.

5. Disconnect the regulator and plug the G-MAN's GENERATOR harness into the plug just removed from the regulator.

6. Plug the G-MAN's REGULATOR harness into the regulator (or a known good regulator).

7. Re-install the starter solenoid making sure all connections are secure. Re-connect the battery negative cable. The 12 VDC POWER indicator comes on. If not, check for battery voltage at the BAT. terminal of the starter solenoid and P1-10. Make sure there is no voltage at the GROUND test jack (P1-5) with respect to the frame. The LOL/LOP SWITCH indicator should <u>not</u> be on. If it is, check the oil level before starting. This circuit can be checked at

the LOL/LOP SWITCH test jack. A voltage near zero means that the switch is closed (low oil level) or that the wire on P1-12 is shorted to ground.

8. Connect the DMM negative lead to the GROUND test jack and the positive lead to the 12 VDC POWER test jack. A fully charged battery in good condition should read 12.6 to 12.8 VDC. Charge the battery if necessary.

9. Turn on the IGNITION/FUEL switch. The fuel pump should be heard working. If not, check the wiring from P1-2, and the fuel pump. Apply 12 VDC directly to the pump if necessary.

10. Press the START button and the engine cranks. If not, check the wiring from P1-6 and the start solenoid. The battery voltage should not fall below 9.5 VDC during cranking. If so, check the battery condition and cables. The IGNITION/FUEL switch is used to stop the engine.

11. During cranking, the FIELD FLASH indicator will be on. Field flash is energized automatically during cranking and until generator voltage builds. The field flash can also be tested manually at any time by pressing the FIELD FLASH button. Measure the field flash voltage at the FIELD FLASH test jack. It should be 11 VDC, minimum. If not, check the wiring between P1-9 and regulator pin 7.

12. After the engine starts, the FIELD FLASH indicator goes off and the RUN RLY and L1 AC VOLTS indicators come on. This indicates that the L1 line voltage has pulled in the run relay in the G-MAN and that the starter is locked out. If not, check the wiring on P1-4.

13. The STATOR AC VOLTS indicator should be on, indicating that the main stator is producing at least minimum voltage. If not, proceed to the *Generator* and/or *Regulator* section. If the STATOR AC VOLTS indicator is on, and the L1 AC VOLTS indicator is not on, check wiring on P1-4. If neither the L1 AC VOLTS nor STATOR AC VOLTS indicators are on, proceed to *Generator* and *Regulator* tests.

14. The FIELD VOLTS indicator should be on, indicating that the regulator is producing at least 40 VDC (minimum field). If not, proceed to the *Generator* and/or *Regulator* section.

15. If all of the above tests are satisfactory, the engine should be run with the control board in place and the battery charging function checked (if equipped) by noting the rise in battery voltage with the generator running.

Operation of an LP model is the same with a few exceptions. There is no fuel pump and a solenoid valve controls the flow of LP gas. On models equipped with LP shutoff, a closed switch (to ground) on this circuit will prevent starting or will shut down the engine if it is running. The LP SHUTOFF indicator on the G-MAN will be on if this switch is closed.

Control Boards 300-4901 and 300-5337

1. Connect the adapter 56-A360-4901 to the G-MAN CONTROL harness.

2. Remove the two T25 screws. Disconnect the control board and remove the panel.

3. Disconnect the regulator and plug the G-MAN's GENERATOR harness into the plug just removed from the regulator.

4. Plug the G-MAN's REGULATOR harness into the regulator (or a known good regulator).

5. Connect the adapter to the engine control harness the same way as the control board was connected. The 12 VDC POWER indicator comes on. If not, check for battery voltage at the BAT. terminal on the starter solenoid and P1-7. Make sure there is no voltage at the GROUND test jack (P1-11) with respect to the frame.

6. Connect the DMM negative lead to the GROUND test jack and the positive lead to the 12 VDC POWER test jack. A fully charged battery in good condition should read 12.6 to 12.8 VDC. Charge the battery if necessary.

7. Turn on the IGNITION/FUEL switch. The fuel pump should be heard working. If not, check the wiring from P1-12, and the fuel pump. Apply 12 volts directly to the pump if necessary.

8. Press the START button and the engine cranks. If not, check the wiring from P1-9, and the start solenoid. The battery voltage should not fall below 9.5 VDC during cranking. If so, check the battery condition and cables. The IGNITION/FUEL switch is used to stop the engine.

9. During cranking, the FIELD FLASH indicator will be on. Field flash is energized automatically during cranking and until generator voltage builds. The field flash can also be tested manually at any time by pressing the FIELD FLASH button. Measure the field flash voltage at the FIELD FLASH test jack. It should be 11 VDC, minimum. If not, check the wiring between P1-1 and regulator pin 7.

17. After the engine starts and oil pressure builds, the LOL/LOP SWITCH indicator will come on indicating that the oil pressure switch has closed to ground. A voltage near zero at the LOL/LOP SWITCH test jack means that the switch is closed. If the LOL/LOP indicator does not come on, the cause is likely a stuck switch. Starting the engine several times, or tapping on the switch can sometimes cure this. A broken wire from the switch to P1-5 can also be the cause.

18. After a few seconds, the FIELD FLASH indicator goes off and the RUN RLY indicator comes on. This indicates that the run relay in the G-MAN has pulled in and that the starter is locked out. It also indicates that the B1-B2 stator (P1-2, P1-4) is producing voltage. If the

RUN RELAY indicator does not come on, there may be a problem with the generator or regulator. In this case, proceed to the *Generator* and/or *Regulator* section.

19. The FIELD VOLTS indicator should be on, indicating that the regulator is producing at least 40 VDC (minimum field). If not, proceed to the *Generator* and/or *Regulator* section.

20. The STATOR AC VOLTS indicator should be on, indicating that the main stator is producing at least minimum voltage. If not, proceed to the *Generator* and/or *Regulator* section.

21. Measure the battery charging voltage at the BAT. CHG. VOLTS test jack. It should be 18 to 20 VDC. If not, proceed to the *Generator* and/or *Regulator* section.

22. Measure the battery-charging resistor by connecting the DMM (set to lowest ohms range) positive lead to the BAT. CHG. RESISTOR test jack and the negative lead to the generator frame. Do not use the GROUND test jack as this will result in an erroneous reading. The resistance reading should be 2.3 to 3.0 ohms or 5.0 to 6.0 ohms, depending on the model. If not, check the battery charging resistor, ground connection and wiring to P1-3.

23. If all of the above tests are satisfactory, the engine should be run with the control board in place and the battery charging function checked (if equipped) by noting the rise in battery voltage with the generator running.

Operation of LP models (BGEL, NHEL) is the same, with a few exceptions. There is no fuel pump and a solenoid valve controls the flow of LP gas. For added safety, ignition relay (K5) grounds the stop circuit if voltage to the ignition coil is lost. Before starting, the LP SHUTDOWN indicator will be on, showing that K5 is grounding the stop circuit. This indicator should go off as soon as the ignition circuit and K5 become energized.

Control Boards 300-5299, 300-4456

1. Connect the adapter 56-A360-5299 to the G-MAN control harness.

2. Remove the access cover and control panel. Disconnect the control board.

3. Connect the adapter to the engine control harness the same way as the control board was connected. The 12 VDC POWER indicator comes on. If not, check for battery voltage at the BAT. terminal on the starter solenoid and P1-4. Make sure there is no voltage at the GROUND test jack (P1-7) with respect to the frame.

4. Connect the DMM negative lead to the GROUND test jack and the positive lead to the 12 VDC POWER test jack. A fully charged battery in good condition should read 12.6 to 12.8 VDC.

5. Disconnect the regulator and plug the G-MAN's GENERATOR harness into the plug just removed from the regulator.

6. Plug the G-MAN's REGULATOR harness into the regulator (or a known good regulator).

7. Check oil level before starting. If the oil level is low or if the oil level switch is closed, the magneto will be grounded and the engine will not start in step 9 below. The LOL/LOP SWITCH indicator cannot read out the oil level switch on this model because it is hard-wired to the magneto. If the oil level switch is stuck or defective, it must be disconnected in order to proceed.

8. Turn on the IGNITION/FUEL switch. This removes the ground on the magneto (P2-4). The fuel pump should be heard working. If not, check the wiring from P1-1, and the fuel pump. Apply 12 volts directly to the pump if necessary.

9. Press the START button and the engine cranks. If not, check the wiring from P1-3, and the start solenoid. The battery voltage should not fall below 9.5 VDC during cranking. If so, check the battery condition and cables. The IGNITION/FUEL switch is used to stop the engine.

10. During cranking, the FIELD FLASH indicator will be on. Field flash is energized automatically during cranking and until voltage builds. The field flash can also be tested manually at any time by pressing the FIELD FLASH button. Measure the field flash voltage at the FIELD FLASH test jack. It should be 11 VDC, minimum. If not, check the wiring between P2-3 and regulator pin 7.

11. After the engine starts, the FIELD FLASH indicator goes off and the RUN RLY indicator comes on. This indicates that the B1-B2 voltage (P2-1, P2-2) has pulled in the run relay in the G-MAN and that the starter is locked out.

12. The FIELD VOLTS indicator should be on, indicating that the regulator is producing at least 40 VDC (minimum field). If not, proceed to the *Generator* and/or *Regulator* section.

13. The STATOR AC VOLTS indicator should be on, indicating that the main stator is producing at least minimum voltage. If not, proceed to the *Generator* and/or *Regulator* section.

14. Measure the battery charging voltage at the BAT. CHG. VOLTS test jack. It should be 18 to 20 VDC. The battery-charging resistor cannot be measured at the BAT. CHG. RESISTOR test jack because it is not accessible on this model. It is connected between battery positive and CR1(+).

15. If all of the above tests are satisfactory, the engine should be run with the control board in place and the battery charging function checked (if equipped) by noting the rise in battery voltage with the generator running.

Operation of an LP model is the same with a few exceptions. There is no fuel pump and a solenoid valve controls the flow of LP gas. A separate prime solenoid on the LP regulator permits gas to flow during cranking. The LP SHUTOFF indicator is not used.

Control Modules 300-5046, 327-1413 and 300-5374

1. Connect the adapter 56-A360-5374 to the G-MAN control harness. The procedure for accessing the control module depends on the Onan model. See steps 2 and 3 below, as applicable to your model.

2. On models KY (Spec J and later) and KYD (control modules 300-5046 or 327-1413), the module and start solenoid are attached to a bracket located in the left front corner of the base pan. The bracket assembly is secured by two screws through the front of the base pan and a foot that catches a tab in the bottom of the base pan. After removing the bracket assembly, carefully unplug the 23-pin connector from the module using a small flat-bladed screwdriver to release the latch.

3. On models HGJAB and HGJAC (control module 300-5374), remove the front access cover. Remove the bolt holding the circuit breaker and start/stop switch housing. Move the housing upward and to one side to gain access to the 23-pin connector. Carefully unplug the 23-pin connector from the module using a small flat-bladed screwdriver to release the latch.

4. Connect the G-MAN adapter to the engine control harness the same way as the control module was connected.

5. The 12 VDC POWER indicator on the G-MAN should come on. If not, check for battery voltage at the BAT. terminal on the starter solenoid and P1-8. Make sure there is no voltage at the GROUND test jack (P1-6) with respect to the frame.

6. Connect the DMM negative lead to the GROUND test jack and the positive lead to the 12 VDC POWER test jack. A fully charged battery in good condition should read 12.6 to 12.8 VDC.

7. Plug the G-MAN's GENERATOR harness into the 56-A360-5374 adapter.

8. Plug the G-MAN's REGULATOR harness into a known good Onan 305-0809-01 or Flight Systems Model 305 regulator. For test purposes, this external regulator is substituted for the regulator portion of the control module.

9. Check oil level before starting. The LOL/LOP SWITCH indicator will read out the status of the oil pressure switch and should be "on" prior to starting (300-5374 only). Even if this switch is not operating properly, you will still be able to run the engine.

10. Press the START switch and then the STOP switch on the GENERATOR panel. The LP SHUTDOWN indicator on the G-MAN comes on each time. This step tests the start and stop switches and wiring. The start/stop switch is non-functional during G-MAN testing.

11. Turn on the IGNITION/FUEL switch. This removes the ground on the magnetos (P1-15, P1-20). The fuel pump should be heard working. If not, check the wiring from P1-18, and the fuel pump. Apply 12 volts directly to the pump if necessary. Also, the STATUS indicator on the start/stop switch on the generator panel comes on and the choke heater is powered.

12. Press the START button on the G-MAN and the engine cranks. If not, check the wiring from P1-16, and the start solenoid. The battery voltage should not fall below 9.5 VDC during cranking. If so, check the battery condition and cables. The IGNITION/FUEL switch on the G-MAN is used to stop the engine. This also turns off the fuel pump and the choke heater.

13. During cranking, the FIELD FLASH indicator will be on. Field flash is energized automatically during cranking and until voltage builds. The field flash can also be tested manually at any time by pressing the FIELD FLASH button. Measure the field flash voltage at the FIELD FLASH test jack. It should be 11 VDC, minimum.

14. After the engine starts, the FIELD FLASH indicator goes off and the RUN RLY indicator comes on. This indicates that the AC line voltage (P1-4, P1-5) has pulled in the run relay in the G-MAN and that the starter is locked out. CAUTION: If the RUN RLY indicator is *not* on, the starter is *not* locked out and will engage if the START button is pressed.

15. The FIELD VOLTS indicator should be on, indicating that the regulator is producing at least 35 VDC (minimum field). If not, proceed to the *Generator* and/or *Regulator* section.

16. The STATOR AC VOLTS indicator should be on, indicating that the main stator is producing at least minimum voltage. If not, proceed to the *Generator* and/or *Regulator* section.

17. The LOL/LOP SWITCH indicator should now be off, showing that there is oil pressure (300-5374 only). NOTE: Oil pressure *opens* the switch on this model.

18. If all of the above tests are satisfactory, the engine should be run with the control module in place and the battery charging function checked (if equipped) by noting the rise in battery voltage with the generator running. See fault codes in the Appendix section of this manual.

Operation of an LP model is the same with a few exceptions. There is no fuel pump or choke heater and a solenoid valve controls the flow of LP gas to the throttle body.

CAUTION: If you find it necessary to probe the 23-pin module connector for troubleshooting, use only a mating pin of proper diameter or a test probe that does not exceed 0.050" in diameter. Makeshift test probes can damage the connector's socket contacts resulting in an open or intermittent connection.

Control Module 300-5002

1. Connect the adapter 56-A360-5002 to the G-MAN control harness.

2. Remove the two TORX 25 screws holding the start/stop switch panel in the housing. Fold the panel down and toward you to access the wiring.

3. Unplug the grey 8-pin plug P1 from the control module. Disconnect wire J4-L1 and J3 LO (green) from terminal block TB1 inside the housing. Disconnect wires P6-1 and K5-30.

4. Unplug the two potentiometer wires from the harness.

5. Unplug the control module connector J2 from the remote harness, if equipped, and move the control module assembly out of the way.

6. Connect the adapter grey 8-pin plug to the engine control harness. Connect adapter wire J4-L1 to L1 on terminal block TB1 in the housing. Connect adapter wire J3 LO to LO on terminal block TB1 in the housing. Connect adapter wire J5 30 to the corresponding wire K5 30 on the harness. Connect the adapter wire P6-1 with the red connector (Bat. +) to the corresponding white connector on the harness.

7. The 12 VDC POWER indicator on the G-MAN should now be on. If not, check for battery voltage at the BAT. terminal on the starter solenoid and P1-1 and G-MAN fuse. Make sure there is no voltage at the GROUND test jack with respect to the frame.

8. Connect the DMM negative lead to the GROUND test jack and the positive lead to the 12 VDC POWER test jack. A fully charged battery in good condition should read 12.6 to 12.8 VDC.

9. Plug the G-MAN's GENERATOR harness into the 56-A360-0911G adapter. Disconnect the regulator and connect the adapter to this plug.

10. Plug the G-MAN's REGULATOR harness into the 56-A360-0911R adapter. Connect the adapter to the 305-0911 regulator.

11. The grey 2-pin plug (P8) on the adapter is <u>not</u> connected at this time. It is used later for optional leakage testing of the PMG winding.

12. Check oil level before starting. The LOL/LOP SWITCH indicator will read out the status of the oil pressure switch and should be "off" prior to starting. Even if this switch is not operating properly, you will still be able to run the engine.

13. Turn on the IGNITION/FUEL switch. This supplies 12 volts to the ignition coil (P1-4), the fuel pump (P1-3) and the choke heater (P1-2). The fuel pump should be heard working. If not, check the wiring from P1-3 and the fuel pump. Apply 12 volts directly to the pump if necessary.

14. Press the START button and the engine cranks. During cranking, the red START and green PMG LEDs on the adapter should be on. If not, check the wiring from P1-1, and the start solenoid. The battery voltage should not fall below 9.5 VDC during cranking. If so, check the battery condition and cables. The IGNITION/FUEL switch is used to stop the engine.

15. During cranking, the FIELD FLASH indicator will be on. Field flash is energized automatically during cranking and until voltage builds. The field flash can also be tested manually at any time by pressing the FIELD FLASH button. Measure the field flash voltage at the FIELD FLASH test jack. It should be 11 VDC, minimum. If not, check the wiring between P1-5 on the control harness and P4-7 on the regulator plug.

16. After the engine starts, the FIELD FLASH indicator goes off and the RUN RLY indicator comes on. This indicates that the AC line voltage (P1-4, P1-3) has pulled in the run relay in the G-MAN and that the starter is locked out. CAUTION: If the RUN RLY indicator is *not* on, the starter is *not* locked out and will engage if the START button is pressed.

17. The FIELD VOLTS indicator should be on, indicating that the regulator is producing at least 40 VDC (minimum field). If not, proceed to the *Generator* and/or *Regulator* section.

18. The STATOR AC VOLTS and L1 AC VOLTS indicators should be on, indicating that the main stator is producing at least minimum voltage. If not, proceed to the *Generator* and/or *Regulator* section.

19. The LOL/LOP SWITCH indicator should now be on, showing that there is oil pressure. NOTE: Oil pressure closes the switch on this model.

20. The green PMG LED on the adapter should be on, indicating that the PMG (battery charging) winding is producing voltage. Measure 12.8-13.2 VDC at the 12 VDC POWER jack with respect to the GROUND jack. This voltage should slowly increase as the battery charges.

21. If desired, the PMG winding can be tested for leakage to ground with the G-MAN. To perform this test, stop the engine and unplug the grey 2-pin PMG connector J8 at the back of the generator. Plug the grey 2-pin connector from the adapter into J8. Move the leakage selector to the BAT. STATOR position and press the LEAKAGE TEST button. The LED should *not* light. With the engine running, measure 24 VAC at the BAT. STATOR jacks.

22. If all of the above tests are satisfactory, the engine should be run with the control module in place (restore all wiring to original after disconnecting G-MAN) and the battery charging function (PMG) checked, if equipped, by noting the rise in battery voltage (12.8VDC or greater) with the generator running.

Operation of an LP model is the same with a few exceptions. There is no fuel pump or choke heater and a solenoid valve controls the flow of LP gas. The LP SHUTOFF indicator is not used.

NOTES:

GENERATOR TESTS

Summary of Generator Features

The generator consists of a wound rotor (F1-F2) of either two or four poles that is energized with a DC current controlled by the regulator, and a stator of several windings. The main stator usually consists of two identical windings (T1-T2 and T3-T4) that may be connected several different ways to produce the desired voltage. A quadrature or auxiliary stator (Q1-Q2) produces the voltage to power the regulator. Some generators also have a low-voltage stator (B1-B2) for battery charging. The battery charging components may be part of the engine control board or they may be packaged separately (such as a rectifier or regulator), depending on the model.

How the G-MAN Works

The G-MAN connects between the generator and the regulator to provide access to all circuits for the convenient measurement of resistance and voltage at its test jacks. The FIELD VOLTS indicator comes on when the field voltage reaches 36-38 VDC, as a convenient visual reference. The STATOR AC VOLTS indicator comes on when the main stator is producing at least 75 VAC. A built-in megger steps up the 12 VDC to provide 200 VDC for insulation resistance tests. A leakage current detector turns on the LEAKAGE indicator when the leakage current to ground exceeds 200 microamperes. This corresponds to a leakage resistance to ground of 1 Meg ohm or less, which is the maximum acceptable leakage as specified by Onan. A selector switch provides a convenient means of applying the 200 VDC test voltage to the various windings or it can be set to its OFF position when not in use.

Generator tests are divided into non-running and running tests. Non-running tests are done to measure the resistance of the various windings and to check for shorts and grounds. Also, special tests can be done to detect a flying short, flying open or a flying ground in the rotor (field). These tests are done with the rotor spinning but not energized. The G-MAN can detect grounds that are difficult to find any other way by applying 200 VDC to the winding under test and measuring the leakage current. The G-MAN can also detect winding-to-winding leakage.

Excessive amounts of moisture and/or dirt on generator windings can cause the LEAKAGE indicator to come on, even if the insulation is good. Carbon dust from brushes can be very conductive. This effect may be more noticeable in coastal areas near saltwater or areas with acid rain or high humidity. If this is suspected, the windings should be checked for cleanliness, moisture and any signs of damage. Clean the windings if possible and run the generator under load for at least 20 minutes to bake out any moisture and repeat the test. A bench test may be necessary. Eliminate every possible cause for a high leakage indication before replacing expensive rotor or stator assemblies.

Running tests are normally done at rated RPM with the field energized to check for the proper voltages on the stators and rotor (field) under load and no-load conditions. All generator models have two or more stator windings and one rotor (field) winding. Step by step procedures are given below for all of these tests using the G-MAN and a DMM or VOM.

Generator Resistance Tests (non-running except flying short)

1. Connect the appropriate adapter to the G-MAN CONTROL harness. See APPLICATIONS.

2. Access the control board or module using the appropriate procedure above.

3. Turn the LEAKAGE TEST selector to OFF.

4. Connect the adapter to the engine control harness the same way as the control board was connected. The 12 VDC POWER indicator comes on.

5. Connect the DMM negative lead to the GROUND test jack and the positive lead to the 12 VDC POWER test jack. A fully charged battery in good condition should read 12.6 to 12.8 VDC. Charge battery if necessary.

6. Disconnect the regulator and plug the G-MAN's GENERATOR harness into the plug just removed from the regulator. DO NOT connect the REGULATOR harness to the regulator.

7. Connect the DMM between the red MAIN STATOR test jack T2, T4 and the GROUND test jack and measure approximately 0.0 to 0.1 ohms.

8. Connect the DMM between the red MAIN STATOR test jacks T1,T3 - T2,T4 and measure approximately 0.3 to 0.4ohms.

9. Connect the DMM between the yellow AUX STATOR test jacks Q1-Q2 and measure approximately 2.0 to 3.5 ohms.

10. Connect the DMM between the blue BAT. STATOR test jacks B1-B2 and measure approximately 0.1 to 0.2 ohms.

11. Connect the DMM between the green FIELD test jacks F1-F2 and measure 22-28 ohms. NOTE: Some models will measure lower (15-17 ohms). Consult the applicable Onan service manual for specified values. Resistance readings are temperature dependent and rise with increasing temperature. Values are specified at room temperature (77 F, 25 C $\pm$10%). Readings may vary depending on the rotor position. This is usually caused by slip ring or brush problems. Tap the starter and take several readings. If the reading is high and/or not constant, clean the slip rings and repeat the test. If this does not correct the problem, check the brushes. Excessively low resistance indicates a possible rotor short, while a high resistance indicates slip ring and/or brush problems. Either a high or low resistance condition can lead to regulator failure and must be corrected.

12. All windings should read "infinity" to each other at the test jacks.

Rotor Resistance Test, Flying Short/Open

It is possible, although somewhat uncommon, to have a mechanically induced short, partial short or open in the rotor that shows up only when it is spinning. This type of fault occurs when rotor windings shift slightly due to centrifugal force and can be difficult to track down. To perform this test, proceed as follows.

1. Follow steps 1 through 6 above under *Generator Resistance Tests*.

2. Follow step 11 above under *Generator Resistance Tests,* except use a VOM analog-type meter such as a Simpson 260 in place of the DMM. The DMM will give an erroneous reading because of the small DC voltage induced in the rotor when it is spinning. Connect the VOM positive lead to the F1(+) test jack and the negative lead to the F2(-) test jack. Obtain a stable reading *within the range specified* and record.

3. Start the engine and observe which way the needle moves. A significant drop in resistance indicates a flying short, especially if it is repeatable. A high reading or "infinity" indicates a flying open. A slight apparent rise (1-3 ohms) in field resistance is normal and is due to the small induced voltage in the spinning rotor influencing the VOM. A defective rotor must be repaired or replaced.

Generator Leakage Tests (non-running except flying ground)

1. IMPORTANT: Follow steps 1 through 6 above under *Generator Resistance Tests*.

2. Disconnect generator leads T2 and T4 and regulator LO (pin 3) from the terminal block (Neutral, AC LO or ground). Some models require additional leads to be disconnected.

3. Open the AC circuit breaker to isolate the generator from all external circuits.

4. Set the LEAKAGE TEST selector to MAIN STATOR and press the LEAKAGE button. If the LEAKAGE indicator does <u>not</u> come on, the leakage is OK. If the LEAKAGE indicator comes on, the leakage resistance to ground is below 1 Meg ohm. If the STATOR AC VOLTS indicator comes on, it means that the LO wire has not been disconnected (step 2 above). Connect the black patch cord to the GROUND test jack and leave it there. Connect the other end to the Q2 test jack and repeat the leakage test. If the LEAKAGE indicator comes on, the leakage resistance from T1-T2 to Q1-Q2 is below 1 Meg ohm. Connect the patch cord to B2 and repeat the leakage test. If the LEAKAGE indicator comes on, the leakage resistance from T1-T2 to B1-B2 is below 1 Meg ohm. The test voltage may be read by connecting the DMM between the T1,T2 and GROUND test jacks. The test voltage should be at least 200 VDC. A leakage resistance, if present, will load this voltage down. The lower this voltage goes, the more severe the leak. This principle also applies to the leakage tests below. Disconnect the patch cord from B2 and leave the other end connected to GROUND.

NOTE: On some models, the LEAKAGE indicator will come on along with the L1 AC LINE indicator because of the small current drawn by the indicator. While this is normal, the MAIN STATOR leakage test is still inconclusive. In this case, and just for this test, isolate the main stator (as above) and disconnect the GENERATOR harness. Connect the red alligator clip to one end of the red patch cord and clip onto the stator terminal or wire T1. Connect the other end to the T1,T3 jack on the G-MAN. Set the LEAKAGE TEST selector to MAIN STATOR and press the LEAKAGE button. If the LEAKAGE indicator does not come on, the leakage is OK. If the LEAKAGE indicator comes on, the leakage resistance to ground is below 1 Meg ohm.

5. Set the LEAKAGE TEST selector to AUX STATOR (Q1-Q2) and press the LEAKAGE button. If the LEAKAGE indicator does not come on, the leakage is OK. If the LEAKAGE light comes on, the leakage resistance to ground is below 1 Meg ohm. Connect the patch cord to the B2 test jack and repeat the leakage test. If the LEAKAGE indicator comes on, the leakage resistance from Q1-Q2 to B1-B2 is below 1 Meg ohm. Disconnect the patch cord at both ends.

6. Set the LEAKAGE TEST selector to BAT. STATOR (B1-B2) and press the LEAKAGE button. If the LEAKAGE indicator does not come on, the leakage is OK. If the LEAKAGE indicator comes on, the leakage resistance to ground is below 1 Meg ohm.

7. Set the LEAKAGE TEST selector to FIELD (F1-F2) and press the LEAKAGE button. If the LEAKAGE indicator does not come on, the leakage is OK. If the LEAKAGE indicator comes on, the leakage resistance to ground is below 1 Meg ohm.

Rotor Leakage Test, Flying Ground

It is possible, although somewhat uncommon, to have a mechanically induced ground in the rotor that shows up only when it is spinning. This type of fault occurs when rotor windings shift slightly due to centrifugal force and/or heating and can be difficult to track down. To perform this test, proceed as follows.

1. Follow steps 1 through 6 above under *Generator Resistance Tests.*

2. Set the LEAKAGE TEST selector to FIELD (F1-F2) and press the LEAKAGE button. If the LEAKAGE indicator does not come on, the leakage is OK. If the LEAKAGE indicator comes on, the leakage resistance to ground is below 1 Meg ohm.

3. Start the engine and repeat step 2 above. If the LEAKAGE indicator comes on *only* when the engine is running, this indicates a flying ground. If possible, verify results with a VOM (such as a Simpson 260) connected between the F1(+) and GROUND test jacks. Repeat the test to be certain before replacing an expensive rotor. NOTE: A digital meter such as a Fluke will not give reliable resistance readings on low ohms if there is any residual voltage present in the circuit.

Generator Voltage Tests

> To prevent possible damage to external circuits or appliances, MAKE SURE that the AC CIRCUIT BREAKER IS OFF during control and generator testing.

1. Follow the steps under *Procedures by Control Board Part Number* above, as appropriate, and start the engine. The FIELD VOLTS and STATOR AC VOLTS indicators should be on showing that the regulator is working.

2. Connect the DMM to the red MAIN STATOR (T1,T3 – T2,T4) test jacks. Read 118-128 VAC at no-load.

3. Connect the DMM to the yellow AUX. STATOR (Q1-Q2) test jacks. Read 140-160 VAC at no-load.

4. Connect the DMM to the blue BAT. STATOR (B1-B2) test jacks. Read 18-20 VAC at no-load.

5. Connect the DMM to the green FIELD (F1-F2) test jacks, observing polarity. Read 36-44 VDC at no-load. If the field voltage is abnormally high at no-load, check for brush and/or slip ring problems. The field voltage should rise in response to an AC load applied to the generator. The field voltage will also rise with temperature because of an increase in rotor resistance. NOTE: An AC field voltage reading can be observed but it is not meaningful.

REGULATOR TESTS

Summary of Regulator Features

The primary function of the regulator is to keep the generator output voltage nearly constant from no-load to full rated load. It does this by sensing the generated voltage and frequency and constantly adjusting the average field current up or down, as needed. A secondary function of the regulator is to flash the field on initial start-up. The internal circuitry also gets its power from the 12 VDC field flash circuit until the generator builds voltage. The regulator is powered by the quadrature (AUX.) stator, Q1-Q2, after the generator is producing voltage. To better understand how the regulator works, refer to the Block Diagram in the *Charts and Illustrations* section. There are variations in the regulator pin assignment for the different part numbers and applications. See the *Regulator Pin Assignment Chart*.

Different parts of the regulator can fail, resulting in different symptoms being exhibited. For example, if the field flash function is failed, the generator will likely not build voltage. This problem can be diagnosed by measuring the field flash voltage. Another example would be a shorted output-switching transistor. This would cause the generator to have full field all the time, regardless of load, and have an excessively high output voltage. This problem can be diagnosed by measuring the field voltage at no-load. A failure in the frequency sensing circuitry

will result in regulation at the wrong voltage. This problem can be diagnosed by substituting a known good regulator. The tests below using the G-MAN are designed to determine if the regulator is faulty, and in some cases, even determine what part of the regulator has failed.

How the G-MAN Works

The G-MAN provides access to all regulator circuits at its test jacks for convenient voltage measurement, as well as the FIELD VOLTS and STATOR AC VOLTS indicators for quick visual reference. A means is provided to flash the field and also to apply a limited amount of field current with the regulator disconnected, allowing the generator to produce 40% of rated voltage at no-load. A known good test regulator can be easily substituted at any time without disturbing the installed regulator. A test regulator is also substituted for the regulator portion of the 300-5046, 327-1413 and 300-5374 control modules.

Procedure

To prevent possible damage to external circuits or appliances, MAKE SURE that the AC CIRCUIT BREAKER IS OFF during regulator testing as overvoltage could occur.

1. Connect the G-MAN CONTROL, GENERATOR and REGULATOR harnesses according to the *Procedures by Control Board Part Number* above.

2. Start the engine. If the FIELD VOLTS and STATOR AC VOLTS indicators are not on, proceed to step 4. Otherwise measure the frequency at the MAIN STATOR (T1,T3-T2,T4) test jacks and adjust the governor if necessary for 60-62 Hz. If the frequency is out of tolerance with an electronic governor, replace the governor.

3. Measure the voltage at the MAIN STATOR (T1,T3-T2,T4) test jacks. If this voltage is below 115 VAC or above 130 VAC at no-load, shut down the engine. Substitute a known good regulator and repeat the test. If the voltage is now within tolerance, the regulator is faulty and must be replaced. If the voltage is still high, check the wiring between generator terminal T1 and regulator pin 2. An open circuit on this wire will cause an overvoltage condition. If the voltage is low, check the wiring between AC LO or NEUTRAL and regulator pin 3, and the wiring between regulator pins 4 and 5 or 1 and 5, as applicable. NOTE: Some models use a potentiometer between these pins instead of a jumper.

4. This step applies only if the regulator will not start (no voltage). Shut down the engine. Substitute a known good regulator and repeat the test. If the MAIN STATOR voltage is now within tolerance, the regulator is faulty and must be replaced. If the FIELD VOLTS and STATOR AC VOLTS indicators are still not on, check the wiring between the control board and regulator pin 7. NOTE: Pressing the FIELD FLASH button applies approximately 11.5 VDC directly to regulator pin 7. This voltage can be measured at the FIELD FLASH test jack. If the regulator is disconnected or not making contact at pin 7, the field flash voltage will be slightly higher, typically 11.9 to 12.0 VDC. This is one way to determine if pin 7 is making contact. If pin 7 is known to be making contact, and the regulator will not start, check the wiring between ground and regulator pin 3. If the field flash circuit is working

properly, pressing the FIELD FLASH button with the generator running will cause a rise in voltage at the MAIN STATOR test jacks.

5. This is really a *generator* test, however its purpose here is to eliminate any doubt as to the ability of the generator to produce voltage. This is accomplished by providing a source of field current independent of the regulator. DISCONNECT REGULATOR. Connect the red patch cord between the FIELD FLASH test jack and the F1(+) test jack. Connect the black patch cord between GROUND and the F2(-) test jack. Connect the DMM to the MAIN STATOR test jacks. Start the engine and observe that there is little or no voltage being produced. Press and hold the FIELD FLASH button. If the generator is working properly, the DMM should read approximately 50 VAC, and the STATOR AC VOLTS indicator will glow dimly (it may not be bright enough to see in direct sunlight). The AUX. STATOR (Q1-Q2) should read approximately 60 VAC and the BAT. STATOR (B1-B2), if equipped, should read approximately 8.0 VAC. These voltages are approximately 40% of rated voltage.

6. The filter capacitors on regulators that are connected to pin 8 (305-0782, 305-0809, 305-0852 and 305-0897 may be checked for value and leakage with the G-MAN. Proceed as follows:

   a) Connect the CONTROL and GENERATOR harnesses only, not the REGULATOR harness.

   b) Leave the capacitor (+) terminal (pin 8) connected, but disconnect the capacitor (-) terminal (pin 6). Using the black patch cord and alligator clip, connect the capacitor (-) terminal to the GROUND test jack on the G-MAN.

   c) Do not start the engine. Set the LEAKAGE selector to CAPACITOR. Press and hold the LEAKAGE button. The LEAKAGE indicator should stay on for approximately 40 to 50 seconds for a good 220 MFD capacitor. If the LEAKAGE indicator does not come on at all, the capacitor is open or not connected. If it goes off too soon, the capacitor has a lower than normal capacitance value. If it does not go off at all, the capacitor is leaky. The capacitor may be observed charging by connecting the DMM positive lead to the CAPACITOR test jack and the negative lead to the GROUND test jack. The meter will extend the charging time slightly. The LEAKAGE indicator should go off when the capacitor voltage reaches about 190 VDC. If the voltage "hangs up" and fails to reach this value, the capacitor is leaky.

CAUTION: Capacitors may retain their charge for some time after testing and can present a shock hazard.

   d) Capacitors that are connected internally but not connected to pin 8, (Flight Systems Model 305, Onan 305-0851, 300-5046, 327-1413, 300-5374) or have pin 8 grounded (Onan 305-0826, 305-0911, Flight Systems Models 826, 911), cannot be tested with the G-MAN because there is no access to its terminals.

7. When all other regulator problems have been resolved, the gen set should be load tested with the regulator that is to remain installed. Proceed as follows:

   a) Connect the DMM at the MAIN STATOR test jacks.

   b) Make sure that there is no commercial power connected to the system. Connect a convenient load, such as a ceramic-type electric heater, to the external circuit outlet and close the AC line circuit breaker. More than one heater may be needed.

   c) Start the generator and add load in approximately 1 KW increments.

   d) The MAIN STATOR voltage should be within 123 VAC at no-load and 117 VAC at full rated load. The quadrature voltage between the Q1 and Q2 test jacks should remain nearly constant at 140-150 VAC. The rectified quadrature voltage between the F1(+) test jack and the GROUND test jack should remain nearly constant at 195-205 VDC.

   e) The field voltage at the F1(+) and F2(-) test jacks should start out at 32-40 VDC with a cold generator at no-load, and increase as load is added. A typical rate of rise of field voltage for a 4 KW generator is about 7.5 to 8.0 VDC for each 1 KW of load. At a load of 4 KW, the field voltage should be approximately 62-66 VDC. This voltage will rise slightly as the windings heat up, even at constant load, because of the increase of winding resistance with rising temperature.

COMPONENT TESTS

A variety of components can be tested with the leakage function of the G-MAN. A test voltage of 200VDC is available, however the current is limited to less than 6 ma. To use this feature, connect the CONTROL harness to a source of 12 VDC by using one of the control board adapters or the universal pigtail adapter (56-A360-08). Connect the red alligator clip to the red test lead and connect the other end to the CAPACITOR test jack. Connect the black alligator clip to the black test lead and connect the other end to the GROUND test jack. Set the LEAKAGE selector to CAPACITOR. Follow instructions below for each component type.

Rectifier Diodes and Bridges (PIV 250 VDC min.)

Rectifier Forward: Red lead to the anode, black lead to the cathode (band). Press button. LEAKAGE indicator lights.
Rectifier Reverse: Black lead to the anode, red lead to the cathode (band). Press button. If LEAKAGE indicator lights, diode is defective.

Bridge Forward: Red lead to (-), black lead to each AC (~). Black lead to (+), red lead to each AC (~). Press button each time. LEAKAGE indicator lights.
Bridge Reverse: Red lead to (+), black lead to each AC (~). Black lead to (-), red lead to each AC (~). Press button each time. If LEAKAGE indicator lights, bridge is defective.

Zener Diodes, MOV's and Transient Suppressors (up to 180 V, any wattage rating)

Connect a DMM to the CAPACITOR and GROUND test jacks and patch cords, observing polarity.
Forward: Red lead to the anode, black lead to the cathode (band). Press button. LEAKAGE indicator lights and meter reads 0.7 VDC.
Reverse: Black lead to the anode, red lead to the cathode (band). Press button. LEAKAGE indicator lights and meter reads the zener or suppressor voltage.
MOV,s (and some suppressors) are non-polarized and should measure the same voltage in both directions.

Capacitors (polarized or non-polarized, 250 VDC min. rating)
Do not test capacitors with a voltage rating less than 250 VDC, as they may explode causing injury. Observe polarity on polarized capacitors. Connect a DMM to the CAPACITOR and GROUND test jacks and patch cords, observing polarity. Connect the red lead to the positive terminal and the black lead to the negative terminal of the capacitor to be tested. Press and hold the LEAKAGE button. The capacitor will charge to 200 VDC or slightly higher as indicated on the DMM. The LEAKAGE indicator will be on as the capacitor is charging and will go off when the capacitor is charged, unless it is leaky. The larger the capacitor, the longer the LEAKAGE indicator will stay on. A 10 MFD capacitor will charge in about 3 seconds, a 100 MFD capacitor in about 20 seconds and a 220 MFD capacitor in about 45 seconds.

CAUTION: Capacitors may retain their charge for some time after testing and can present a shock hazard.

Transformers
Transformers can be tested for grounds and isolation between windings. The test setup is the same as for capacitors. For grounds, connect the black lead to the transformer core or frame and the red lead to one terminal of each winding, one at a time. For winding-to-winding isolation, connect the black lead to one winding (such as primary) and the red lead to a different winding (such as secondary). Continue the process until all windings have been tested. Inductors, solenoid coils, and governor actuators can be tested the same way.

Rotors and Stators
Rotors and stators can be bench checked for grounds and winding-to-winding isolation. The test setup is the same as for transformers. For grounds, connect the black lead to the shaft, core or frame and the red lead to one terminal of each winding, one at a time. For winding-to-winding isolation, connect the black lead to one stator winding (such as T1) and the red lead to a different stator winding (such as Q1). Continue the process until all windings have been tested.

Neon Indicators
Neon-type indicators can be easily tested. The test setup is the same as for zener diodes. Polarity is generally not critical, although the indicator may glow somewhat brighter with one polarity than the other. Most neon indicators begin to glow at about 65-70 VDC.

LED Indicators
LED-type indicators can be easily tested. Do not use the 200 VDC leakage test for LED indicators. Connect the red lead to the LP SHUTOFF test jack and the black lead to the GROUND test jack. Observe polarity. The test current will be limited to approximately 14 ma. for an LED without a resistor and about half of this value for an LED that includes a series resistor. The LP SHUTOFF indicator and the LED indicator being tested should both light.

ACCESSORIES

Accessories are available to enhance the usefulness of the G-MAN and to enable the owner to realize a greater return on the initial investment. These accessories consist of control harness adapters for various control boards, patch cords, alligator clips, a universal pigtail adapter, a slip ring cleaning tool (*Slick Stick*) and exhaust hoses (*X-Duct*). New adapters are being developed and will be announced on our web site, **flightsystems.com**, as they become available.

56-A360-2784	Adapter for 300-2784, 300-2943
56-A360-3056	Adapter for 300-3056, 300-3687 and 300-3950 (included with G-MAN)
56-A360-3763	Adapter for 300-3763 and 300-5268 (included with G-MAN)
56-A360-3764	Adapter for 300-3764, 300-5342, 300-4902 and 300-5276
56-A360-4155	Adapter for 300-4155, 300-3797
56-A360-4320	Adapter for 300-4320, 300-4923
56-A360-4901	Adapter for 300-4901, 300-5337
56-A360-5299	Adapter for 300-5299, 300-4456
56-A360-1413	Adapter for 300-5046, 327-1413
56-A360-5002	Adapter for 300-5002
56-A360-5374	Adapter for 300-5374
56-A360-04	Patch Cord, Black, 24 inch, Stackable Banana both ends (included).
56-A360-05	Patch Cord, Red, 24 inch, Stackable Banana both ends (included).
56-A360-06	Alligator Clip, Insulated, Black, Banana-type (included).
56-A360-07	Alligator Clip, Insulated, Red, Banana-type (included).

56-A360-08	Adapter, Universal Pigtail (for bench testing).
56-A360-09	*Slick Stick* Slip Ring Cleaning Tool.
56-A360-10	Hose and Cord Carrier.
56-A360-11	X-DUCT Exhaust Hose, 8' 4", with Carrier
56-A360-12	X-DUCT Exhaust Hose, 12' 6", with Carrier
56-A360-13	X-DUCT Exhaust Hose, 25', with Carrier

WARRANTY

The MODEL 360 G-MAN is warranted to be free from defects in materials and workmanship for a period of two years from the date of shipment. FLIGHT SYSTEMS' liability is limited to the repair or replacement of defective product within the warranty period and does not cover incidental costs incurred (labor, travel, etc.), or possible damage to other equipment (including generator sets and any connected appliances) as a result of a malfunction of the G-MAN.

If, in the opinion of FLIGHT SYSTEMS (or its authorized agent), the malfunction of or damage to the G-MAN was caused by abuse, misuse or improper application, the warranty claim will be disallowed and established repair rates shall apply.

Units should be shipped, freight charges prepaid, directly to FLIGHT SYSTEMS,
207 Hempt Road, Mechanicsburg, PA 17050. USA

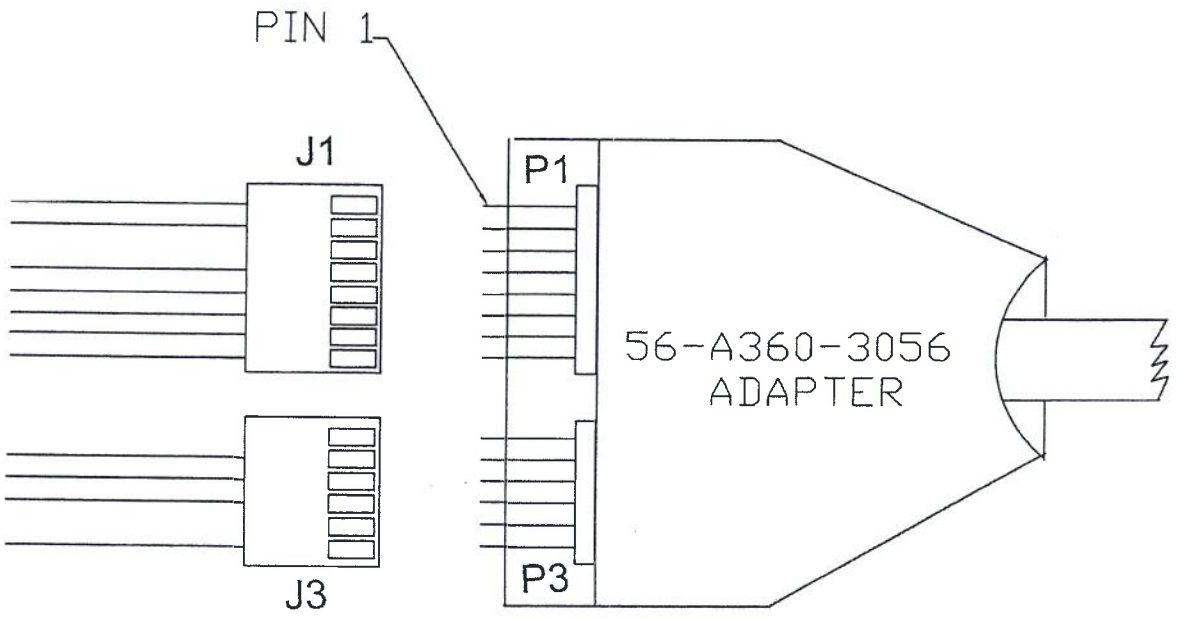
REPAIR SERVICE

The Model 360 G-MAN is fully repairable. Service, Technical Support and Accessories are available through the manufacturer.

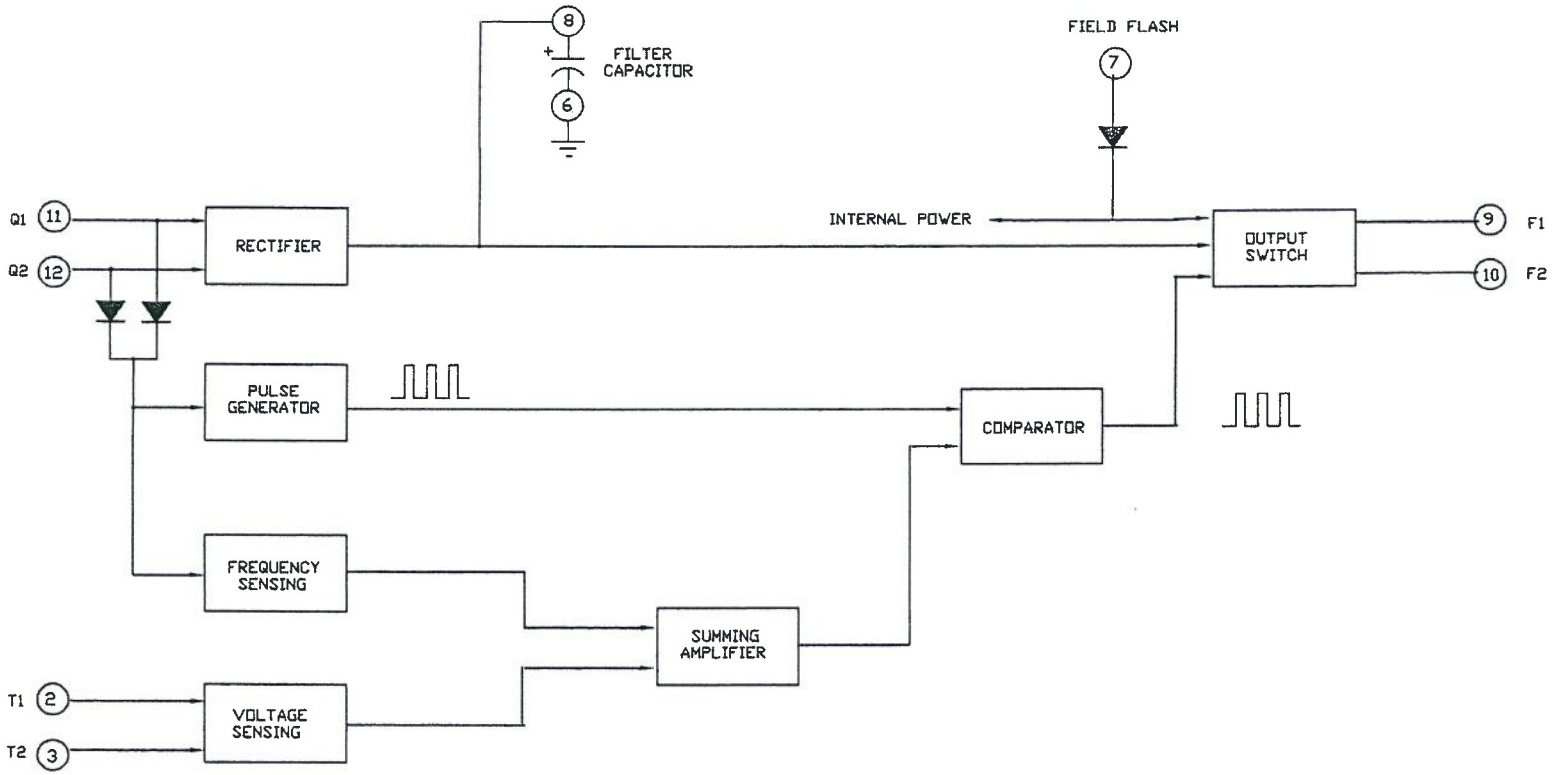
FLIGHT SYSTEMS INC.
207 Hempt Road
Mechanicsburg PA 17050

Ph: 800 403 3728 / 717 590 7330
Fax: 717 590 7327

www.flightsystems.com
techs@flightsystems.com



CONNECTING THE 56-A360-3056 ADATPTER



REGULATOR BLOCK DIAGRAM

APPLICATION CHART FOR 120V 60 Hz RV GENERATORS

SERIES	MODEL	SPEC	KW	FUEL	CONTROL BOARD/MODULE		VOLTAGE REGULATOR		GOVERNOR		G-MAN ADAPTOR
					ONAN P/N	FSI REPLACEMENT	ONAN P/N	FSI REPLACEMENT	ONAN P/N	FSI REPLACEMENT	
EMERALD	BGE	A-E	4.0	GAS	300-2784	56-2784-00	TRANSFORMER	N/A	MECHANICAL	N/A	56-A360-2784
	BGE	F, G	4.0	GAS	300-3056	56-3056-00	305-0782-01	MODEL 305			56-A360-3056
	BGE	H-M	4.0	GAS	300-3763	56-3763-00	305-0809-01	MODEL 305			56-A360-3763
	BGE	N & UP	4.0	GAS	300-4901	56-4901-00	305-0809-01	MODEL 305			56-A360-4901
	BGEL	A-D	4.0	LP	300-2943	56-2943-00	TRANSFORMER	N/A			56-A360-2784
	BGEL	E-G	4.0	LP	300-3056	56-3056-00	305-0809-01	MODEL 305			56-A360-3056
	BGEL	H-M	4.0	LP	300-3763	56-3763-00	305-0809-01	MODEL 305			56-A360-3763
	BGEL	N & UP	4.0	LP	300-4901	56-4901-00	305-0809-01	MODEL 305			56-A360-4901
	NHE	A-C	6.5	GAS	300-2784	56-2784-00	TRANSFORMER	N/A			56-A360-2784
	NHE	D-G	6.5	GAS	300-3056	56-3056-00	305-0782-01	MODEL 305			56-A360-3056
	NHE	H-M	6.5	GAS	300-3763	56-3763-00	305-0809-01	MODEL 305			56-A360-3763
	NHE	N & UP	6.5	GAS	300-4901	56-4901-00	305-0809-01	MODEL 305			56-A360-4901
	NHEL	A-C	6.3	LP	300-2943	56-2943-00	TRANSFORMER	N/A			56-A360-2784
	NHEL	D, E, & G	6.3	LP	300-3056	56-3056-00	305-0782-01	MODEL 305			56-A360-3056
	NHEL	H-M	6.3	LP	300-3763	56-3763-00	305-0809-01	MODEL 305			56-A360-3763
	NHEL	N & UP	6.3	LP	300-4901	56-4901-00	305-0809-01	MODEL 305			56-A360-4901
MARQUIS	BGM	A	5.5	GAS	300-3056	56-3056-00	305-0826	MODEL 826	MECHANICAL	N/A	56-A360-3056
	BGM	A	5.5	GAS	300-3763	56-3763-00	305-0826	MODEL 826	MECHANICAL	N/A	56-A360-3763
	BGM	B-F	5.5	GAS	300-3764	56-3764-00	305-0826	MODEL 826	151-0752	56-0752-00	56-A360-3764
	BGM	G & UP	5.5	GAS	300-4902	56-4902-00	305-0826	MODEL 826	151-0752	56-0752-00	56-A360-4902
	NHM	A	6.8	GAS	300-3056	56-3056-00	305-0826	MODEL 826	MECHANICAL	N/A	56-A360-3056
	NHM	A	6.8	GAS	300-3763	56-3763-00	305-0826	MODEL 826	MECHANICAL	N/A	56-A360-3763
	NHM	B-F	6.8	GAS	300-3764	56-3764-00	305-0826	MODEL 826	151-0752	56-0752-00	56-A360-3764
	NHM	G & UP	6.8	GAS	300-4902	56-4902-00	305-0826	MODEL 826	151-0752	56-0752-00	56-A360-4902
MICROLITE	KV	A, B	2.5/2.8	LP/GAS	N/A	N/A	305-0852	MODEL 305/2.8	MECHANICAL	N/A	N/A
	KV	C-L	2.5/2.8	LP/GAS	300-5299	56-5299-00	305-0897	MODEL 305/2.8			56-A360-5299
	KY	A	3.6/4.0	LP/GAS	300-4155	56-4155-00	305-0851	MODEL 305			56-A360-4155
	KY	B-E	3.6/4.1	LP/GAS	300-4320	56-4320-00	305-0851	MODEL 305			56-A360-4320
	KY	F-H	3.6/4.2	LP/GAS	300-4923	56-4923-00	305-0851	MODEL 305			56-A360-4923
	KY	J & UP	3.6/4.3	LP/GAS	300-5046	56-1413-00	300-5046	56-1413-00			56-A360-5374
CAMP POWER	KVC	A	2.8	GAS	300-5299	56-5299-00	305-0897	MODEL 305/2.8	MECHANICAL	N/A	56-A360-5299
	KVD	A	2.5/2.8	LP/GAS	300-5299	56-5299-00	305-0897	MODEL 305/2.8			56-A360-5299
	KYD	A	3.6/4.0	LP/GAS	327-1413	56-1413-00	327-1413	56-1413-00			56-A360-5374

APPLICATION CHART FOR 120/240V 60 Hz COMMERCIAL MOBILE HOME STANDBY GENERATORS

SERIES	MODEL	SPEC	KW	FUEL	CONTROL BOARD/MODULE		VOLTAGE REGULATOR		GOVERNOR	G-MAN ADAPTOR
					ONAN P/N	FSI REPLACEMENT	ONAN P/N	FSI REPLACEMENT		
EMERALD COMMERCIAL MOBILE	BGD	A-C	4.5	GAS/LP	300-3056	56-3056-00	305-0809-05	MODEL 305-5	MECHANICAL	56-A360-3056
	BGD	D-H		GAS/LP	300-3763	56-3763-00				56-A360-3763
	BGD	J & UP		GAS/LP	300-5002-01	N/A	305-0911	MODEL 911		56-A360-5002KIT
	NHD	A-C	6.3-6.5	GAS/LP	300-3056	56-3056-00	305-0809-05	MODEL 305-5		56-A360-3056
	NHD	D-H		GAS/LP	300-3763	56-3763-00				56-A360-3763
	NHD	J & UP		GAS/LP	300-5002-01	N/A	305-0911	MODEL 911		56-A360-5002KIT
MARQUIS GOLD MOBILE GENSET	HGJAA	A-E	5.5-7.0	GAS/LP	300-5503	N/A	300-5503	N/A	MECHANICAL	N/A
	HGJAA	J & UP		GAS EFI	A032Y912	56-5047C-00*	A032Y912	56-5047C-00*	PART OF CONTROL	56-A360-5047C
	HGJAB	A-E		GAS/LP	300-5374	56-5374-00	300-5374	56-5374-00	MECHANICAL	56-A360-5374
	HGJAB	J & UP		GAS/LP	A032Y912	56-5047C-00*	A032Y912	56-5047C-00*	MECHANICAL	56-A360-5047C
	HGJAC	A-C		GAS/LP	300-5374	56-5374-00	300-5374	56-5374-00	MECHANICAL	56-A360-5374
	HGJAD	A-C		GAS EFI	A032Y912	56-5047C-00*	A032Y912	56-5047C-00*	PART OF CONTROL	56-A360-5047C
	HGJAD	J & UP		GAS/LP	A032Y912	56-5047C-00*	A032Y912	56-5047C-00*	PART OF CONTROL	56-A360-5047C
	HGJAE	A-C		GAS/LP	300-5047	56-5047C-00*	300-5047	56-5047C-00*	MECHANICAL	56-A360-5047C
	HGJAE	J & UP		GAS/LP	A032Y912	56-5047C-00*	A032Y912	56-5047C-00*	MECHANICAL	56-A360-5047C
	HGJAF	A-C		GAS/LP	300-5047	56-5047C-00*	300-5047	56-5047C-00*	MECHANICAL	56-A360-5047C
RESIDENTIAL STANDBY	12GHAB	A & UP	11-10	LP/NG	300-5046-01	N/A	300-5046-01	N/A	0814-0107	N/A
	12GHAB	A & UP		LP/NG	300-5428		300-5428			
	12GHAB	A & UP		LP/NG	327-1576		327-1576			
	12GRCA	A & UP		LP/NG	300-5046-01		300-5046-01			
	12GRCA	A & UP		LP/NG	300-5428		300-5428			
	12GRCA	A & UP		LP/NG	327-1576		327-1576			
QUIET DIESEL	HDCAA	A	10	DIESEL	305-0953-03	N/A	305-0953-03	N/A	PART OF CONTROL	N/A
	HDCAB	A	12	DIESEL	305-0953-03		305-0953-03			
	HDCAC	A & B	10	DIESEL	305-0953-03		305-0953-03			
	HDCAC	C	10	DIESEL	327-1440-02		327-1440-02			
	HDCAD	A & B	12	DIESEL	305-0953-03		305-0953-03			
	HDCAD	C	12	DIESEL	327-1440-02		327-1440-02			

NOTES: *CARBURETED VERSIONS ONLY - OUR REPLACEMENT CONTROL WILL NOT WORK ON A GENERATORS THAT USE ELECTRONIC FUEL INJECTION

CONTROL BOARD PIN ASSIGNMENT

			300-3950										
		300-2943	300-3687	300-5268	300-5342	300-4155	300-4923	300-5337	300-5276	300-5299		327-1413	
CONTROL BOARD	**G-MAN**	**300-2784**	**300-3056**	**300-3763**	**300-3764**	**300-3797**	**300-4320**	**300-4901**	**300-4902**	**300-4456**	**300-5002**	**300-5046**	**300-5374**
FUNCTION	J-101												
RUN RLY CONT.	1	P1-4	n/c	n/c	P1-5	n/c	n/c	n/c	P1-5	n/c	n/c	n/c	n/c
FUEL PUMP	2	P2-6 *	P3-6	P1-12	P1-4	J1-12	P1-2	P1-12	P1-4	P1-1	J1-3	J1-18	J1-18
FUEL SOLENOID	3	n/c	n/c	n/c	P1-6 **	n/c	P1-3	n/c	P1-6 **	n/c	J1-2#	J1-11	J1-11
L1 AC LINE	4	n/c	n/c	n/c	n/c	n/c	P1-4	n/c	n/c	n/c	J4-L1	J1-4	J1-4
GROUND	5	P1-8 P2-1	P1-8	P1-11	P1-1	J1-4	P1-5	P1-11	P1-1	P1-7	J3-LO	J1-6	J1-6
START SOLENOID	6	P1-2	P1-2	P1-9	P1-2	J1-8	P1-6	P1-9	P1-2	P1-3	P6-1	J1-16	J1-16
BAT. CHG. RES.	7	P1-1	P1-4	P1-3	n/c	n/c	n/c	P1-3	n/c	n/c	n/c	n/c	n/c
IGNITION ENABLE	8	n/c	n/c	n/c	n/c	J1-6	P1-11	n/c	n/c	P2-4	n/c	J1-15	J1-15,20
FIELD FLASH	9	P1-5	P1-5	P1-1	P1-3	J1-5	P1-9	P1-1	P1-3	P2-3	J1-5	n/c	P102-7
BATTERY POS.	10	P1-6	P1-6	P1-7	P1-7	J1-10	P1-10	P1-7	P1-7	P1-4	J1-1	J1-8	J1-8
IGNITION	11	P1-3	P3-3	P1-6	P1-12	n/c	n/c	P1-6	P1-12	n/c	J1-4	J1-19, 23	J1-19, 23
OIL LOL/LOP SW	12	P1-4	P3-4	P1-5	P1-5	J1-7	P1-12	P1-5	P1-5	n/c	J1-6	J1-7	J1-13
LP SHUTDOWN	13	P2-2	P3-2	P1-10	n/c	n/c	n/c	P1-13	n/c	n/c		J1-14	J1-14
B1	14	n/c	P1-1	P1-2	n/c	J1-9	n/c	P1-2	n/c	P2-1	P3-1	n/c	n/c
B2	15	n/c	P1-7	P1-4	n/c	J1-11	n/c	P1-4	n/c	P2-2	P3-2	n/c	n/c
LOCAL START		P3-3				J1-1	P1-13				J10	J1-7	J1-7
LOCAL STOP		P3-2				J1-2	P1-1				J9	J1-14	J1-14
LOCAL RETURN		P3-1				J1-3	P1-7				J8	J1-5	J1-5
REMOTE START			P2-3	J2-3	J2-3		J2-3	P1-14	P1-9	P1-6	J2-2	J1-7	J1-7
REMOTE STOP			P2-2	J2-2	J2-2		J2-2	P1-10	P1-8	P1-5	J2-1	J1-14	J1-14
REMOTE RETURN			P2-1	J2-1	J2-1		J2-1		n/c	P1-8	J2-5	J1-5	J1-5
BAT. METER			P2-5	J2-5	J2-5		J2-5	P1-16	P1-11	n/c	J2-4	J1-19	J1-19
TIME TOTAL			P2-6	J2-6	J2-6		J2-6	P1-15	P1-10	P1-2	J2-3	J1-19	J1-19
STATUS												J1-23	J1-23
PMG+											J1-7		
PMG-											J1-8		

NOTES: * Remote Run Simulation
** 12 VDC to Electronic Governor
# 12 VDC to Electric Choke

Revised: 3/28/07

REGULATOR PIN ASSIGNMENT

FSI Model Number	305	305	305-5	305-2.8	826	911	
Onan Part Number(s)	305-0872			305-0852			327-1413
	305-0809-01	305-0851	305-0809-05	305-0897	305-0826	305-0911	300-5046
FUNCTION							
AC Sense HI	2	2	2	2	2	2	J1-4
AC Sense LO/Gnd	3	3	3	3	3	3	J1-5
Voltage Adjust	4	4	4	1	4	4	internal
Voltage Adjust Return	5	5	5	5	5	5	internal
Capacitor Negative	6	n/c	6	6	n/c	n/c	internal
Field Flash	7	7	7	7	7	7	internal
Case Ground					8	8	
Capacitor Positive	8	n/c	8	8	n/c	n/c	internal
Field F1(+)	9	9	9	9	9	9	J1-1
Field F2(-)	10	10	10	10	10	10	J1-10
Quad (Aux) Stator Q1	11	11	11	11	11	11	J1-9
Quad (Aux) Stator Q2	12	12	12	12	12	12	J1-3

CONTROL BOARD P/N SUPERCEDENCE

ORIGINAL P/N	SUPERCEEDS TO P/N		
300-2784	300-2943		
300-3056	300-3687	300-3950	
300-3763	300-5268		
300-3764	300-5342		
300-3797	300-4155		
300-4320	300-4923		
300-4901	300-5337		
300-4902	300-5276		
300-4456	300-5299		
300-5046	327-1413		

FLIGHT SYSTEMS

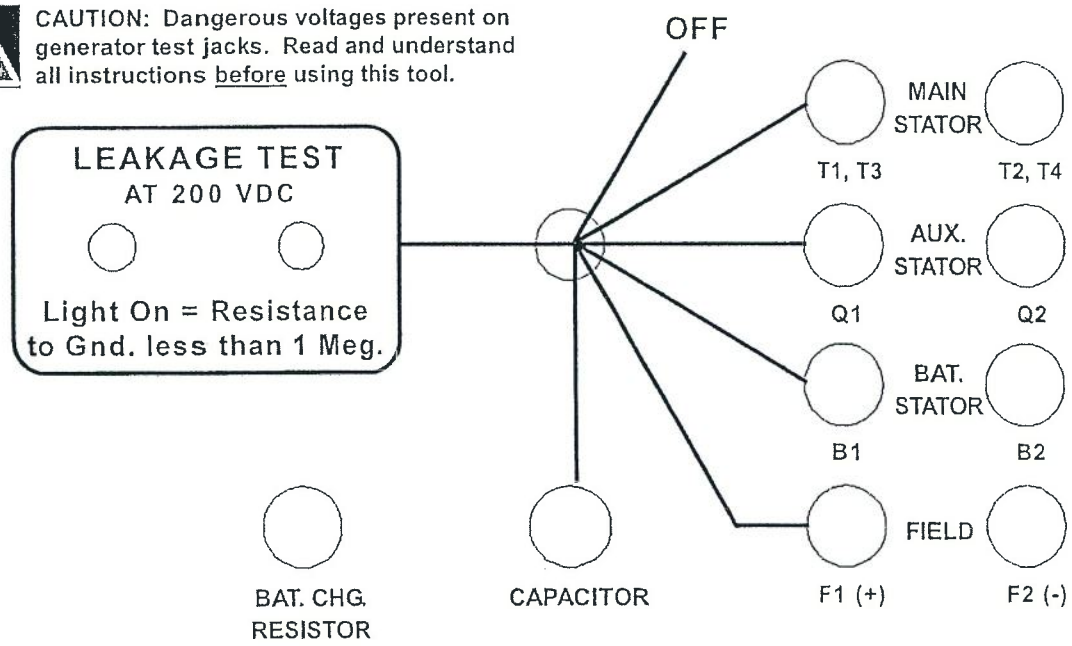
G-MAN®

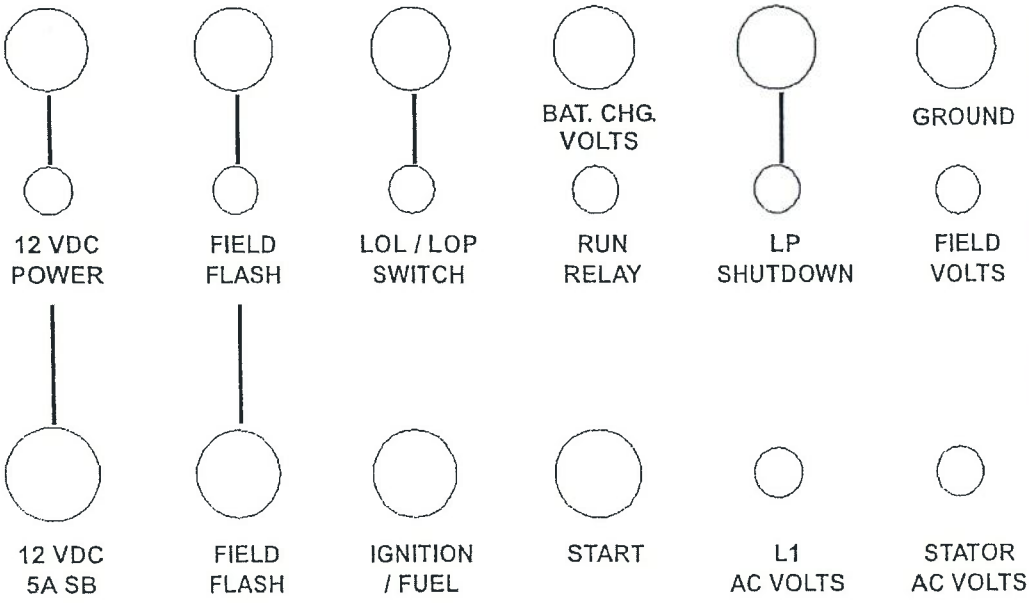
GENERATOR MAN

RV GEN SET SERVICE TOOL

www.flightsystems.com

CAUTION: Dangerous voltages present on generator test jacks. Read and understand all instructions before using this tool.





Model 360 • Made in USA

FAULT CODES FOR 300-5046, 327-1413

Flashing of the STATUS indicator when the control module is connected indicates the presence of a fault code. Three flashes indicates that there is a two-digit code stored (see below). Obtain this code by pressing STOP once. Four flashes indicates an overcrank condition, cranking for more than 20 seconds without an engine start. Pressing STOP twice temporarily suspends the flashing of all two-digit codes. Code flashing ceases automatically after 5 minutes. Pressing STOP three times within 5 seconds will restore flashing of the last code logged. Please refer to the Onan Service Manual (KY Spec. J, KYD Spec. A) for more detailed troubleshooting information.

CODE 12 - Generator output voltage too high.

CODE 13 - Generator output voltage too low.

CODE 14 – Generator running too fast.

CODE 15 – Generator running too slow.

CODE 27 – Generator output voltage not sensed.

CODE 29 – Battery voltage above 19 VDC.

CODE 32 – Cranking speed below 180 RPM for more than 2 seconds during start.

CODE 35 – Control module EEPROM error during self-test.

CODE 36 – Engine stopped by itself, not by a signal from the control module.

CODE 37 – Invalid genset configuration.

CODE 38 – High field current (generally caused by motor starting surges or low power factor).

CODE 41 – Field voltage not sensed (possible rotor fault).

CODE 42 – Control module ROM error during self-test.

CODE 43 - Control module RAM error during self-test.

CODE 45 – Quadrature frequency not sensed.

CODE 48 – Field voltage not sensed (control module fault).