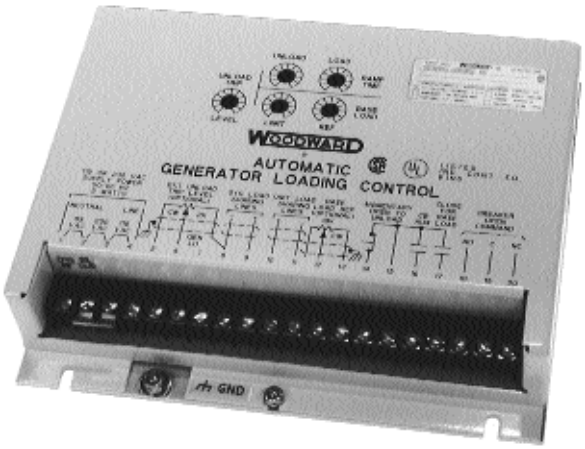
Released

WOODWARD

Product Manual 82004
(Revision D, 2/2021)
Original Instructions



AGLC Automatic Generator Loading Control

9905-096 (UL and CSA Listed)
9903-545

Installation and Operation Manual

General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.

Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, on the *publications page* of the Woodward website:

http://www.woodward.com

The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.

Proper Use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. Be sure to check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

Revisions— A bold, black line alongside the text identifies changes in this publication since the last revision.

Manual 82004

Contents

Illustrations and Tables

Warnings and Notices

Important Definitions

This is the safety alert symbol used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER** - Indicates a hazardous situation, which if not avoided, will result in death or serious injury.
- **WARNING** - Indicates a hazardous situation, which if not avoided, could result in death or serious injury.
- **CAUTION** - Indicates a hazardous situation, which if not avoided, could result in minor or moderate injury.
- **NOTICE** - Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT** - Designates an operating tip or maintenance suggestion.

⚠WARNING

Overspeed / Overtemperature / Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

⚠WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

⚠WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

⚠WARNING

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE

Battery Charging Device

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

Regulatory Compliance

The 9905-096 AGLC is UL and CSA Listed.

The 9903-545 AGLC is for replacement use only and is unlisted in North America.

Chapter 1.
General Information

Description

The Automatic Generator Loading Control (AGLC) is an auxiliary control (see Figures 1-1 and 1-2). It is designed to be used with a load sharing and speed control to automatically control the loading and unloading of an engine-generator set. The AGLC accomplishes a bumpless transfer when paralleling an engine generator set to a load-sharing system or separating an engine-generator set from a load-sharing system.

Relay K1 energizes on power-up. The AGLC activates when the generator-breaker auxiliary contacts close. Relay K3 energizes and the load sequence starts (see Figure 1-2). The AGLC compares the existing potential on the load-sharing lines of the oncoming generator with the potential on the system load-sharing lines. Starting at the existing load level, the generator load is ramped at a preset rate until the voltage on the unit load-sharing lines matches the voltage on the system load-sharing lines. When the voltages match, relay K2 energizes to connect the unit load-sharing lines to the system load-sharing lines and to isolate the load ramp signal.

The unload sequence is initiated by momentarily opening the unload contacts. The AGLC de-energizes load-sharing relay K2 (in AGLC) to separate the generator load-sharing lines from the system load-sharing lines. The K2 contacts in series with K3 close again to reconnect the loading ramp signal through K3 contacts to the unit load-sharing lines.

The AGLC then ramps the load down at a preset rate to a preset unload level. When the unload level is reached, the AGLC de-energizes relay K1 to automatically issue a breaker-open command. This command is used to separate the engine generator set from the paralleled system. After the circuit breaker auxiliary (CB AUX) contracts open (indicating the breaker has opened) the AGLC disconnects the ramp from the unit load-sharing lines and relay K1 is energized. The AGLC is then ready to energize relay K3 when it receives a contact closure signal from the CB AUX contacts to load the set again.

The unload procedure may be aborted by opening the CB AUX contacts while the Unload Switch is closed.

IMPORTANT

The AGLC activate (circuit breaker auxiliary) contacts must open when the circuit breaker is opened to reset the AGLC. If they do not, the unit will not be able to go online again.

The AGLC includes a base-load function. Whenever the AGLC is activated, the base load function can be activated by a contact closure. This function can be used in one of two modes; either as a system control to load against a utility or as a unit control to isolate a single generator set from a load-sharing system and load that set to a specific load. The second mode can also be used when a controlled unload is desired without taking the generator set offline. The external base load reference can be changed to a lower or higher level. The load will then ramp to that new level. The set can then be ramped back up to the system load by opening the base-load contact.

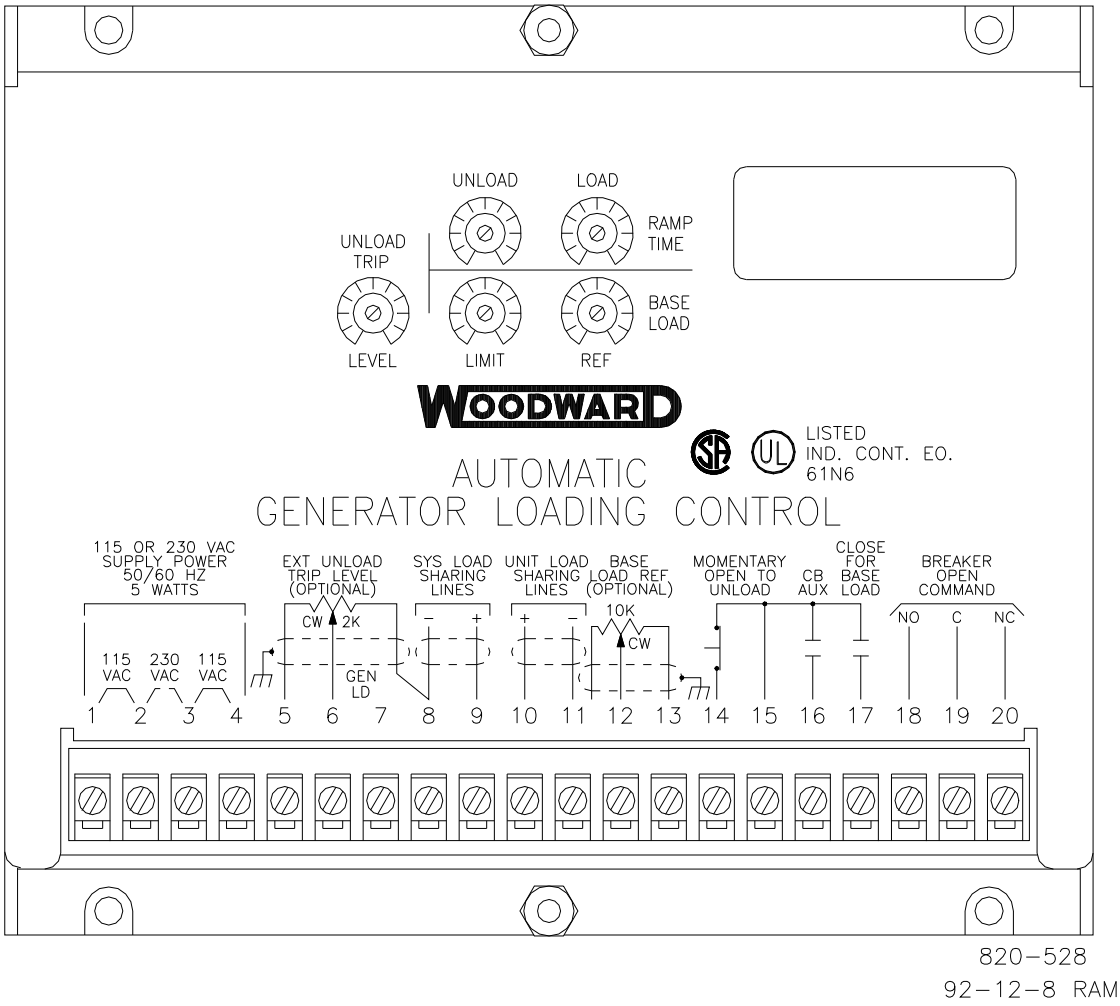


Figure 1-1. Automatic Generator Loading Control

When the base load Is activated, the AGLC Isolates the engine-generator set load-sharing lines by energizing relay K2 This opens $K2_1$ and closes $K2_2$ (as shown in Figure 1-2). This separates the generator load-sharing lines from the system load-sharing lines and closes the ramp-circuit signal through $K2_2$ to the unit load-sharing lines. The load on the engine generator Is ramped up or down to the base-load setting. The base-load setting can be adjusted to different load levels (with the ramps still in effect) while operating in the base-load mode.

The load increases or decreases at preset rates. A base-load limit prevents overloading. This adjustment sets maximum base-load demand. When the AGLC is used as a unit control, opening the base-load contacts automatically ramps the engine-generator set back into the load-share system. Opening the breaker auxiliary contacts (which activate the AGLC without opening the baseload activate contacts) removes the base-load bias signal from the system. Re-closing the breaker auxiliary contacts will then ramp the system back into base load.

As a system control, one AGLC can be used to base load from one to fifteen engine generator sets against a utility. In this mode, the system load-sharing lines are connected to the AGLC unit load-sharing lines. The AGLC system load-sharing lines are not used (see Figure 2-3).

All AGLC controlled load changes start at the existing load on the engine generator set or on the system being controlled. This eliminates load bumps when separating from another system or connecting to another system (following proper synchronization). The up and down ramp rates are linear. These rates are set by the load and unload time adjustments. The ramps are independently adjustable from five seconds to five minutes for load changes equal to 100% of rated load.

The AGLC provides a zero to one mA meter drive signal (see Figure 4-1). This signal is proportional to the load-sharing line voltage reference level. A zero to one mA meter connected to this signal will indicate load demand on, or power level of, the local generating system. During isolated operation (separated from the utility), the meter output signal is proportional to the actual plant load. When paralleled to the utility, the meter-drive signal will be proportional to the load demand on the generating system. A 1 kΩ range adjustment potentiometer should be installed for calibration of the meter-drive signal.

Compatibility

The AGLC can be used with any Woodward load-sharing and speed control systems with either built-in or external load sensors.

Construction

The AGLC is contained in a sheet-metal enclosure. All electronics in the system are solid state, installed on a single, high-quality, printed-circuit board. All adjustments are available through the front of the control.

The terminal board provides 20 connections for all inputs and outputs. (Not all connections will be required for any one system.)

IMPORTANT **The AGLC is an auxiliary device and must be used with load-sharing speed controls to control prime-mover speed and/or load.**

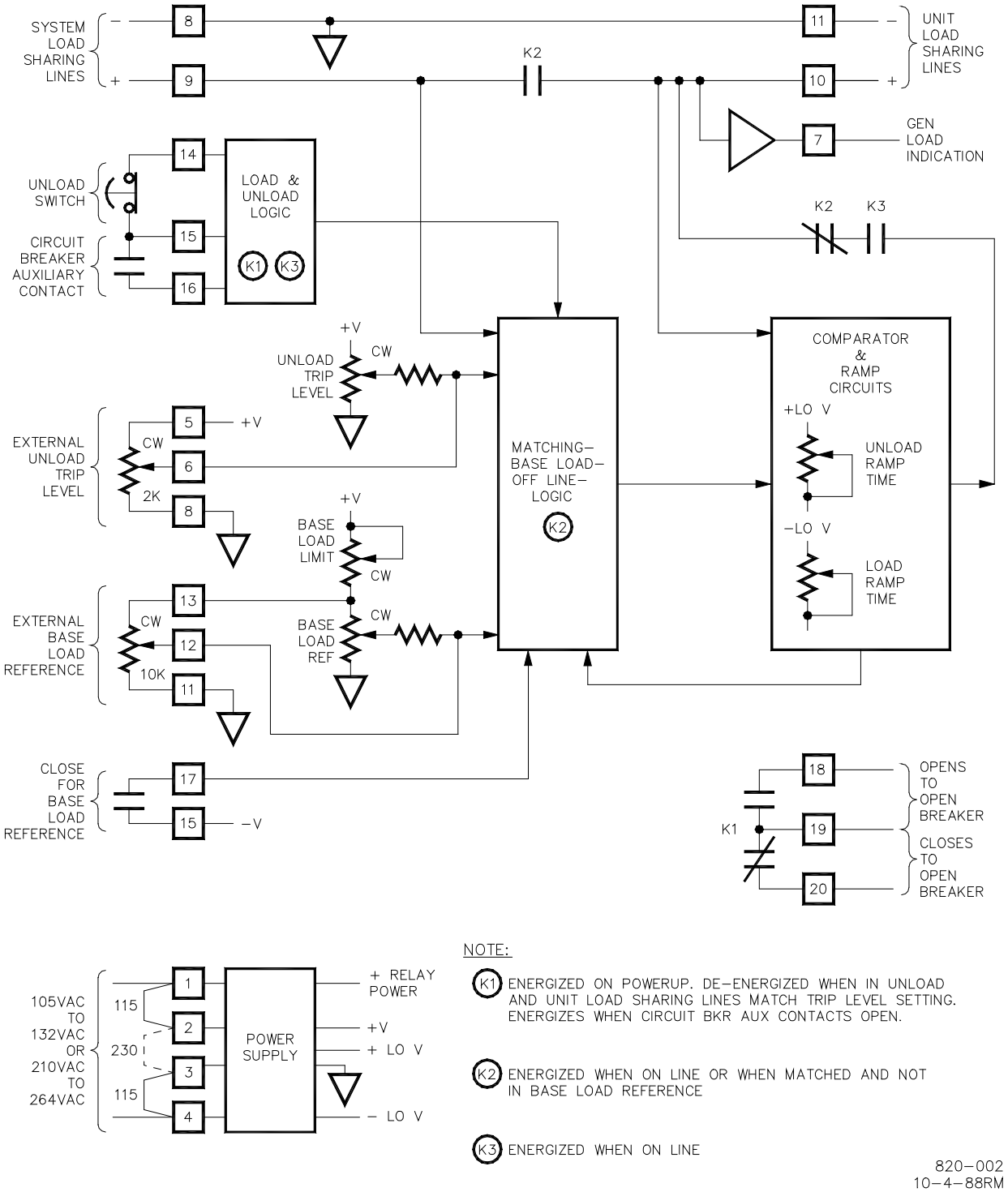


Figure 1-2. AGLC Simplified Block Diagram

Chapter 2.
Applications

Soft Loading an Engine Generator Set into a Load Sharing System

Refer to Figure 2-1. The AGLC is connected between the load-sharing lines of the Load Sharing and Speed Control (LSSC) and the system load-sharing lines. The LSSC load-sharing lines are connected to AGLC terminals 10 (+) and 11 (–) and the system load-sharing lines are AGLC terminals 9 (+) and 8 (–).

The activate terminals (15 and 16) on the AGLC are connected to a set of generator-breaker auxiliary contacts. These contacts close as the generator breaker closes, paralleling the generator to the bus. When tied to the AGLC in this manner, the LSSC control operates in the isochronous load-sharing mode. The AGLC will track the load of the oncoming unit until it is activated.

The Unload Trip Level potentiometer is set to provide the minimal load required to prevent reverse power. On the initial set-up, prior to paralleling, the Unload-Trip-Level potentiometer is set for zero volts between AGLC terminals 7 and 6.

Unload trip level relay K1 will energize on power up (K1 contacts between terminals 18 and 19 close and contacts between terminals 19 and 20 open). When the oncoming generator set is properly synchronized, the paralleling generator breaker closes. The breaker auxiliary contacts close to activate the AGLC.

The recently activated AGLC compares the voltage on the oncoming unit load-sharing lines with the voltage on the system load-sharing lines. The AGLC load ramp then linearly increases the voltage on the unit lines at the rate set by the Load Ramp Time Adjust potentiometer. When the voltages match, relay K2 (which connects the unit and system load-sharing lines) energizes to join the oncoming unit into the load-sharing system.

Soft Unloading an Engine Generator Set Out of a Paralleled Load Sharing System

Refer to Figures 1-2 and 2-1. Unloading is initiated by momentarily opening the unload switch across terminals 14 and 15. Relay K2 (energized to connect the system and unit load-sharing lines) de-energizes, separating the system load-sharing lines from the generator load-sharing lines. At the same time this relay connects the unit's load-sharing lines to the comparator and ramp circuits. The AGLC unload ramp then linearly decreases the voltage on the unit load-sharing lines at a rate set by the Unload-Ramp-Time potentiometer.

When the voltage on the unit load-sharing lines matches the voltage set by the Unload-Trip-Level potentiometer unload-trip-level relay K1 de-energizes to open the contacts between AGLC terminals 18 and 19 and to close those between terminals 19 and 20. These contacts can be used to initiate the opening of the generator breaker.

When the breaker and the auxiliary contacts open relay K1 energizes and the AGLC is reset and ready for the next sequence.

Where the unload switch has momentary contacts and the generator breaker is opened at the unload trip level, reset is obtained automatically. If the automatic sequence is not used, the activate (breaker auxiliary) contacts across terminals 15 and 16 must be opened again before synchronizing and re-closed upon breaker closure before the AGLC can again be used to soft load. When using the AGLC base-load mode (described below) to soft unload the engine generator, recycling the base load contacts is not necessary.

Ramping an Engine Generator out of Load Share into Base Load

Refer to Figures 1-2 and 2-3. When the generator is paralleled and load sharing, closing the base load contacts at terminals 15 and 17 de-energizes K2 to separate the system and unit load-sharing lines. Other K2 contacts also connect the loading ramp signal in series with K3 contacts to control output on unit load-sharing lines.

The AGLC ramps linearly, increasing or decreasing the unit load-sharing-line voltage to match the base load setting. The base-load-limit potentiometer sets the maximum voltage to which the base-load reference can be set. The external base-load potentiometer setting, if used, takes precedence over the internal base-load potentiometer setting.

The base-load limit is set by measuring the voltage between terminals 11 (–) and 12 (+). The Base Load Limit potentiometer is used to set this voltage to match the full load voltage on the unit-load sharing lines. Full load voltage is normally three volts. If an external base-load potentiometer is added after this limit is set, the limit must be reset to compensate for the added parallel resistance.

Opening the base-load contacts initiates the return of the system to load sharing. The unit load-sharing line voltage is ramped up or down until it matches system load-sharing line voltage. Relay K2 then energizes to return the unit to the load-sharing system.

Base Loading an Engine Generator Set Against a Utility

Refer to Figures 1-2 and 2-2. Before this operation can be started, the AGLC unit load-sharing lines (terminals 10 and 11) must be connected to those of the LSSC.

The base load terminals (15 and 17) may be hard wired or connected in series with the activate terminals (15 and 16) and a set of generator breaker auxiliary contacts that are also connected in series with a set of utility breaker auxiliary contacts.

A switch with momentary contacts must be connected across unload terminals 14 and 15. A generator breaker opening circuit must be connected across unload relay contacts at terminals 18/19 or 19/20. No connection to the system load-sharing line terminals 8 (–) and 9 (+) is required.

When the generator breaker closes, its auxiliary contacts close to activate the AGLC and energizes relay K3. The ramp starts at the present load-sharing line voltage and ramps the unit load-sharing line voltage to match the baseload set point voltage. This set point voltage can be adjusted up or down while in the base-load mode. The load will follow at a rate set by the appropriate (load or unload) ramp time potentiometers.

Momentarily opening the unload switch contacts commands the ramp to bring the generator to the unload trip level. When the trip level is reached, breaker relay K1 de-energizes. The generator breaker opens to separate the generator from the utility. The breaker auxiliary contacts open to reset the AGLC and relay K1. The auxiliary contacts will close to reactivate the AGLC on the next generator breaker closure.

Base Loading a Maximum of 15 Engine-Generator Sets, Operating in Parallel Load Sharing, against a Utility

Refer to Figures 1-2 and 2-3, and to “Soft Loading an Engine Generator Set into a Load Sharing System.” In addition to the system AGLC, each engine-generator set in the parallel system should have an AGLC to provide soft loading of its generator in and out of the controlled loop.

Loading a system is accomplished, as it is for one generator, by connecting the AGLC unit load-sharing lines (terminals 10 and 11) to the system load-sharing lines (terminals 8 and 9). Again, the AGLC system load-sharing lines connections (terminals 8 and 9) are not used. Before this operation can be started, the base load activate terminals 15 and 17 must be jumpered. AGLC activate terminals 15 and 16 must be connected to a set of utility-breaker auxiliary contacts.

Closing the utility breaker closes the breaker’s auxiliary contacts and activates the AGLC. The load on the system will be ramped up or down at rates set by the ramp time load and unload potentiometers. Loading stops at the level set by the internal base-load reference or the external base-load reference (if used). When used, the external base-load reference setting takes precedence over the internal reference setting.

The unload contacts at terminals 14 and 15 must be momentarily opened to unload and separate from the utility. When the contacts operate, the load decreases to the unload trip level. This unload trip level should set for the plant load, if one exists. Contacts across terminals 18, 19, and 20 operate to open the utility breaker. When the utility breaker opens, the master AGLC is deactivated and the generator system then operates in isochronous load sharing.

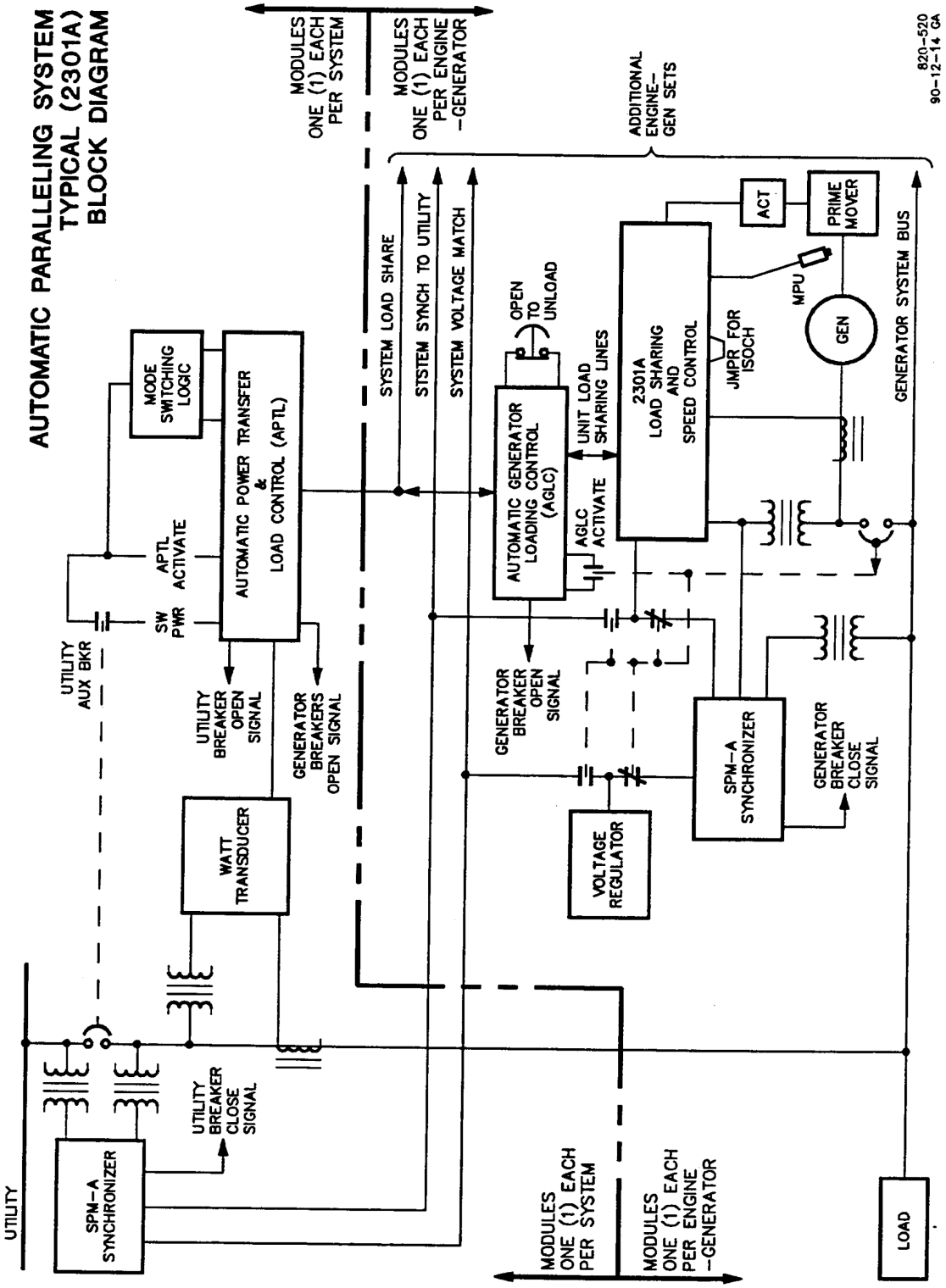


Figure 2-1. Block Diagram of AGLC with APTL Control

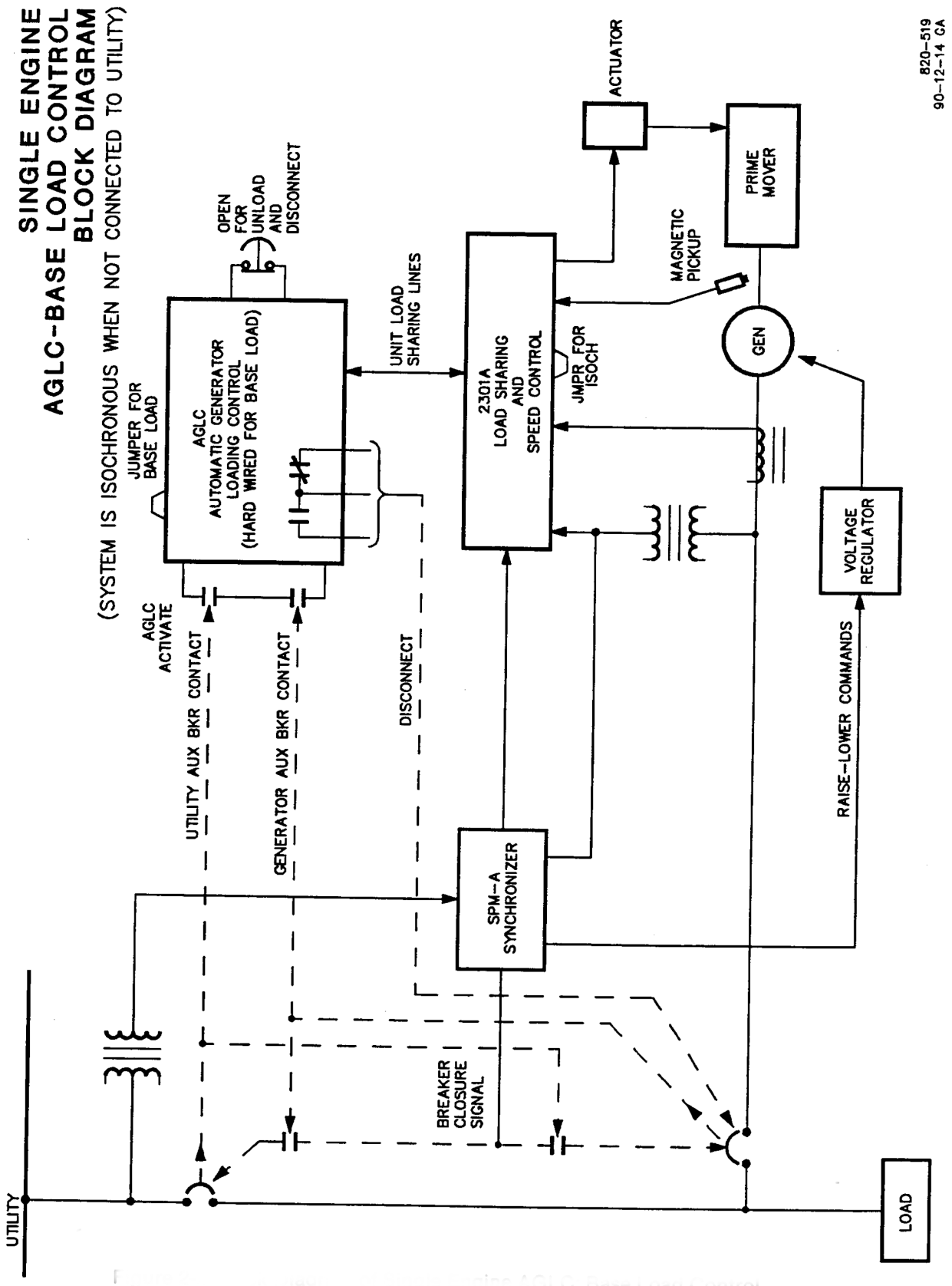


Figure 2-2. Block Diagram of Single Engine AGLC Base Load Control

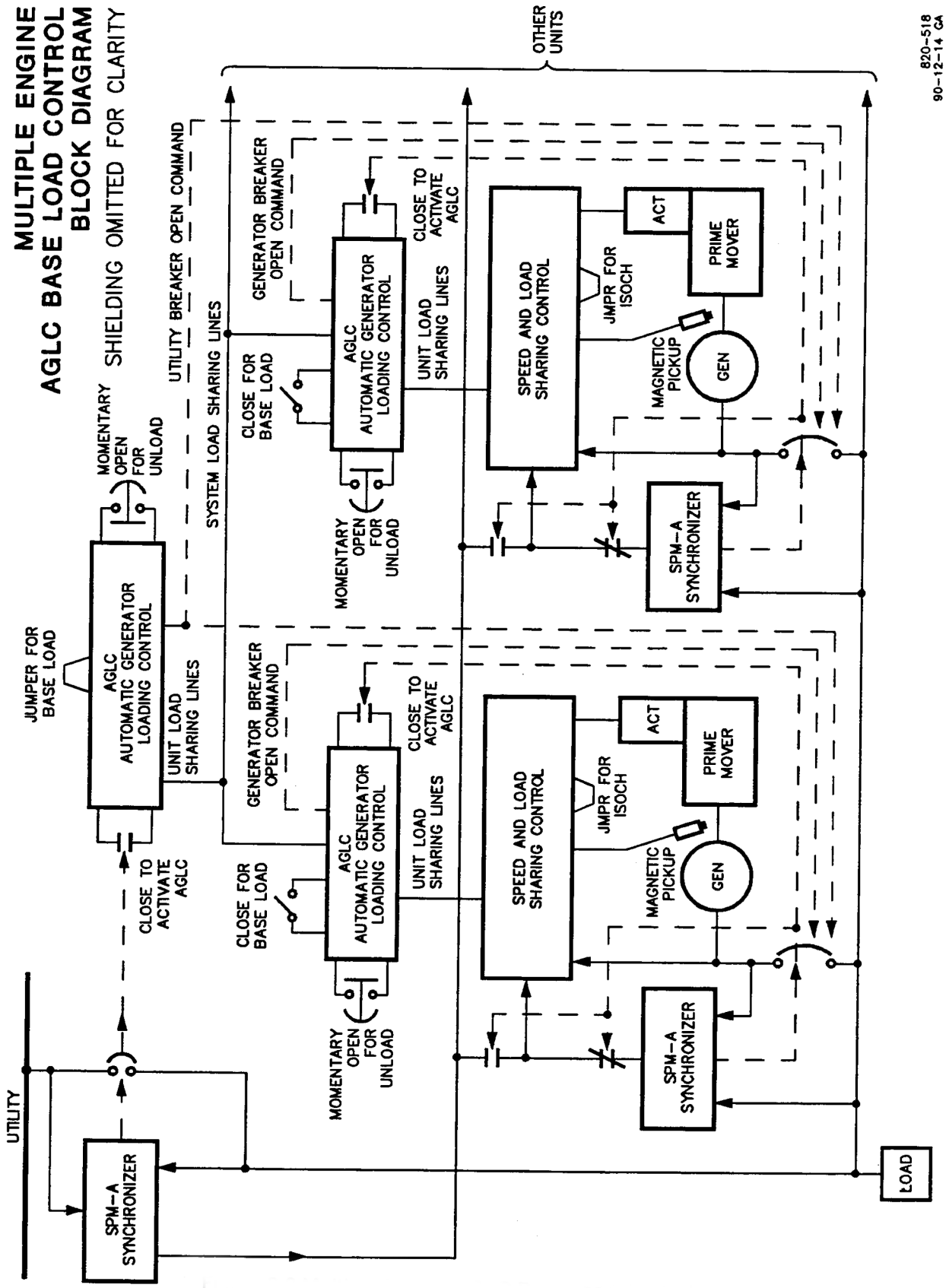


Figure 2-3. Block Diagram of Multiple Engine AGLC Base Load Control

Chapter 3.
Installation

Unpacking

Be careful when unpacking the control. Check the control for signs of damage such as bent or dented case, and loose or broken parts. If damage is found, notify the shipper immediately. The control may be stored in its original shipping container until it is ready for installation. Protect the control from weather and from extreme humidity or temperature fluctuations during storage. The control is shipped enclosed in a special plastic bag which protects it from accidental electrostatic-discharge damage. Do not remove the control from this special package until ready to install it on the control panel.

Power Requirements

The AGLC requires a supply of either 115 Vac or 230 Vac power, either 50 or 60 Hz. The power supply must be uninterrupted while the AGLC is being used in the generating system. The AGLC may be connected to the bus for power.

IMPORTANT **All AGLCs in a system must be powered up when any of the system's AGLCs are used. Failure to do so will create a "droop-like" symptom in the system.**

Location Considerations

Carefully study this chapter before choosing the location for the AGLC. The AGLC can have a number of control options which must be accessed by the operator. The wiring of these options may influence the selection of a location for the AGLC.

Consider the following requirements when selecting the location.

- Adequate ventilation for cooling
- A location that will provide an operating temperature range of –40 to +85 °C (–40 to +185 °F)
- Space for servicing
- Protection from direct exposure to water or to a condensation-prone environment
- Protection from high-voltage or high-current devices, or devices which produce electromagnetic interference
- Avoidance of vibration

The AGLC is usually installed in the control cabinet for convenient access to other plant controls and the various inputs which will be needed.

Shielded Wiring

All shielded cable must be twisted conductor pairs with either a foil or a braided shield. Do not attempt to tin a braided shield. All signal lines should be shielded to prevent picking up stray signals from adjacent equipment. Connect the shields as shown in the plant-wiring diagram (Figure 3-1). Wire exposed beyond the shield must not exceed two inches. The other end of the shields must be left open and insulated from any other conductor. Do not run shielded signal wires with other wires carrying large currents. See manual 50532, EMI Control for Electronic Governing Systems, for more information.

Installations with severe electromagnetic interference (EMI) may require shielded wire run in conduit, double shielded wire, or other precautions. Contact Woodward for more information.

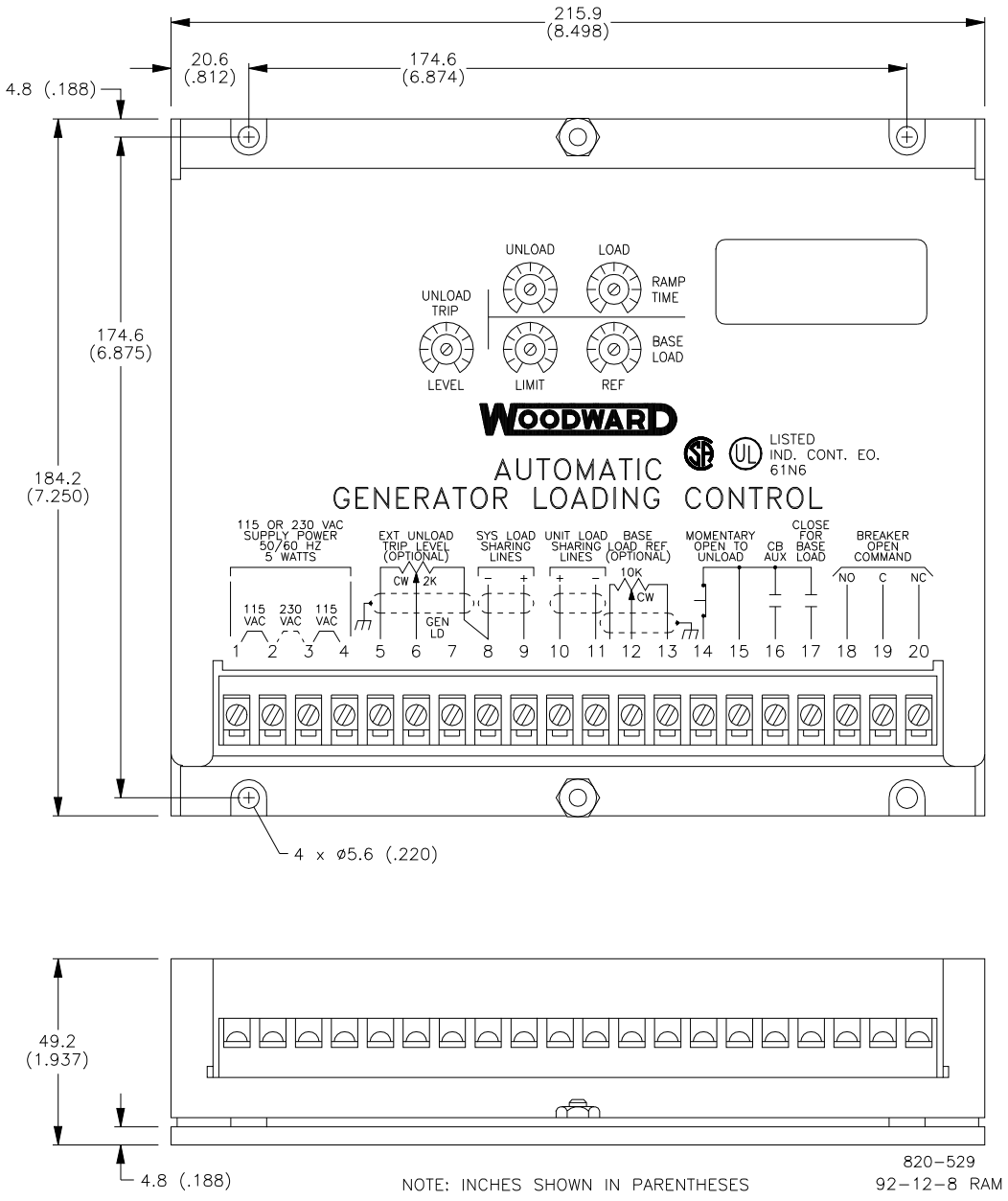


Figure 3-1. Outline Drawing of AGLC

Chapter 4.
Plant Wiring and Adjustments

Introduction

The following information is intended to expand on the requirements for plant-wiring options presented by the AGLC. All wiring options are the responsibility of the installer and the instructions which follow are suggestions only.

Figure 4-1 is the plant wiring diagram for the AGLC. Figure 4-2 shows the interconnections between controls for a typical system.

IMPORTANT

Switch size and type, wire size and type, and potentiometer size and type suggested in this chapter will generally provide adequate operation of the AGLC. Special problems which surround individual installations must be considered and allowed to overrule these suggestions. No consideration to hazardous environments or other special conditions have been made in offering these suggestions.

Power Supply and Operation Selections

Wire Size

Connect the control to the voltage source with a minimum of 20 AWG (0.5 mm²) insulated wire. Connect the wires to the control with crimp-on, insulated, number-6 connectors. If relay contacts are to be used for the full 10 ampere rating, a minimum of 16 AWG (1.0 mm²) wire should be used.

Power Supply

The input power may be from the local bus. 115 V supply must be between 88 and 132 V, 50 or 60 Hz. The 220 V supply must be between 170 and 264 V, 50 or 60 Hz. Maximum current use is 0.10 A.

IMPORTANT

All AGLCs in the system must be powered up during any combination of engine operation, even single engine operation.

Use solid plate-type jumpers to jumper terminals 1 to 2 and 3 to 4 if a 115 Vac supply is being used. Use the same type of jumper to jumper terminals 2 to 3 if a 220 Vac supply is to be used.

Woodward part number 1606-899 is the recommended jumper.

Connect supply leads (either 230 or 115 Vac) to terminals 1 and 4 (polarity is not important). If fused, use a 2 A fuse in series with the supply.

Unload Trip and Base Load Reference Selections

Unload Trip

The unload trip level may be set with the potentiometer in the AGLC or by an external potentiometer. **The external potentiometer will always override the Unload Trip Level set with the internal potentiometer in the AGLC.**

To connect the external unload trip level potentiometer:

Using three conductor shielded wire, connect the clockwise end of a 2 kΩ potentiometer (1/4 watt or greater) to terminal 5. Connect the wiper to terminal 6, and the counterclockwise end to terminal 8.

Connect the shield to the AGLC. Leave the potentiometer end of the shield disconnected.

If a generator load meter reading is desired, connect a 1 mA meter between terminals 7 (+) and 8(–). Install a 1 kΩ potentiometer as shown between terminal 7 and the meter (see Figure 4-1). The potentiometer is used to calibrate the meter. Shield the wires going to the meter with the shield connected at the AGLC end only.

Base Load Reference

The base load reference level may be set with the potentiometer in the AGLC or by an external potentiometer. **The external potentiometer or signal will always override the internal base load reference.**

To connect the external base load reference:

Using three conductor shielded wire, connect the clockwise end of a 10 kΩ potentiometer (1/4 watt or greater) to terminal 13. Connect the counterclockwise end to terminal 11. Connect the wiper to terminal 12. Connect the shield to the AGLC leaving the shield disconnected at the potentiometer end.

If desired, a 0 to 3 V base load reference may be connected directly to terminal 12 (+) and 11 (–); however, this signal must be isolated from the battery and/or other non-Woodward equipment.

If desired, an externally generated 0–10 mA source connected to terminal 11 (–) and terminal 12 (+) may be used to set the base load reference. A 300 Ω resistor (1/4 watt or greater) must be connected across terminals 11 (–) and 12 (+).

Base Load Limit

This potentiometer limits the maximum base-load reference to prevent unit overloading by the internal and/or external base load reference potentiometer. To adjust the limit with the generator offline, adjust the internal and/or external base-load reference potentiometers fully clockwise. Then adjust the Base Load Limit potentiometer for the desired base-load limit voltage level measured at terminals 11 (–) and 13 (+). A typical level is 3 Vdc. If an external base-load potentiometer is added after this limit is set, the limit must be reset to compensate for the added parallel resistance.

Load Sharing Lines

In a multiple engine system with a separate AGLC for each engine and 2301A control, connect 8 (–) and 9 (+) to the system load-sharing lines. Connect terminals 10 (+) and 11 (–) to terminals 10 and 11 on the Load Sharing and Speed Control or Load Sensor. Shields on these connections attach to the system load-sharing shields and to the Load Sharing and Speed Control or Load Sensor, not to the AGLC.

Logic Switches

Switches which determine the function performed by the AGLC are connected to terminals 14, 15, 16, and 17.

Connect a momentary “Open to Unload” switch between terminals 14 and 15. When this circuit is opened the AGLC will cause the attached units to go to the unload trip level at the unload ramp rate. The circuit must be closed for any of the base-load functions to work or to reset the unit so it will be able to load again.

Generator Breaker Contacts

Connect breaker auxiliary contacts that open and close with the generator breakers. Wire the breaker auxiliary contacts in series between terminal 16 and terminal 15. The LSSC or Load Sensor must always be in isochronous mode .

Close for Base Load

Install a Base Load switch between terminals 17 and 15. When the AGLC is activated and this switch is closed, the AGLC will be in the base-load mode and the generator or local system load will increase or decrease at the ramp rate to the previously set base-load level.

Trip Relay

This relay is energized except when the unload trip level is reached or when the unit or system is off line. When the trip level is reached the circuit through terminals 18 and 19 will open and the circuit through 19 and 20 will close. The change in circuit state is used to issue a generator breaker open command. The circuits will remain in the trip position until the switch at terminals 14 and 15 closes and the AGLC trip relay is reset when the generator breaker's auxiliary contacts open.

Table 4-1Breaker Open Relay Contact Rating

	Resistive	**Inductive**	**Motor**	**Lamp**
28 Vdc	10 A	6.0	3.0	1.0
115 V 400 Hz	5 A	2.5	3.0	0.8
115 V 60 Hz	3 A	2.0	1.5	0.5

Potentiometer Adjustments

The five potentiometers accessed through the cover provide all the adjustments for the AGLC.

The unload trip level is set with the extreme left-hand potentiometer on the control. The one-turn potentiometer setting is overridden by any setting which is made on an optional external potentiometer connected to terminals 5, 6, and 7.

The base-load limit is set with a one-turn potentiometer. This limit applies to the base-load limit set with either the potentiometer on the control or the optional remote baseload setting at terminals 11, 12, and 13. The Base Load Limit is used to prevent accidental overloading through the base-load setting.

Ramp times are separately adjustable between 5 seconds to 5 minutes for 100% load change.

Both ramp rates are set with one-turn log-taper potentiometers. The log-taper potentiometer gives finer resolution at the 5-second end of adjustment than it does at the 5-minute end. This provides better resolution where it is required. Clockwise adjustment of the rate potentiometers increases the ramp time (adjusts the ramp toward the 5-minute slow limit.)

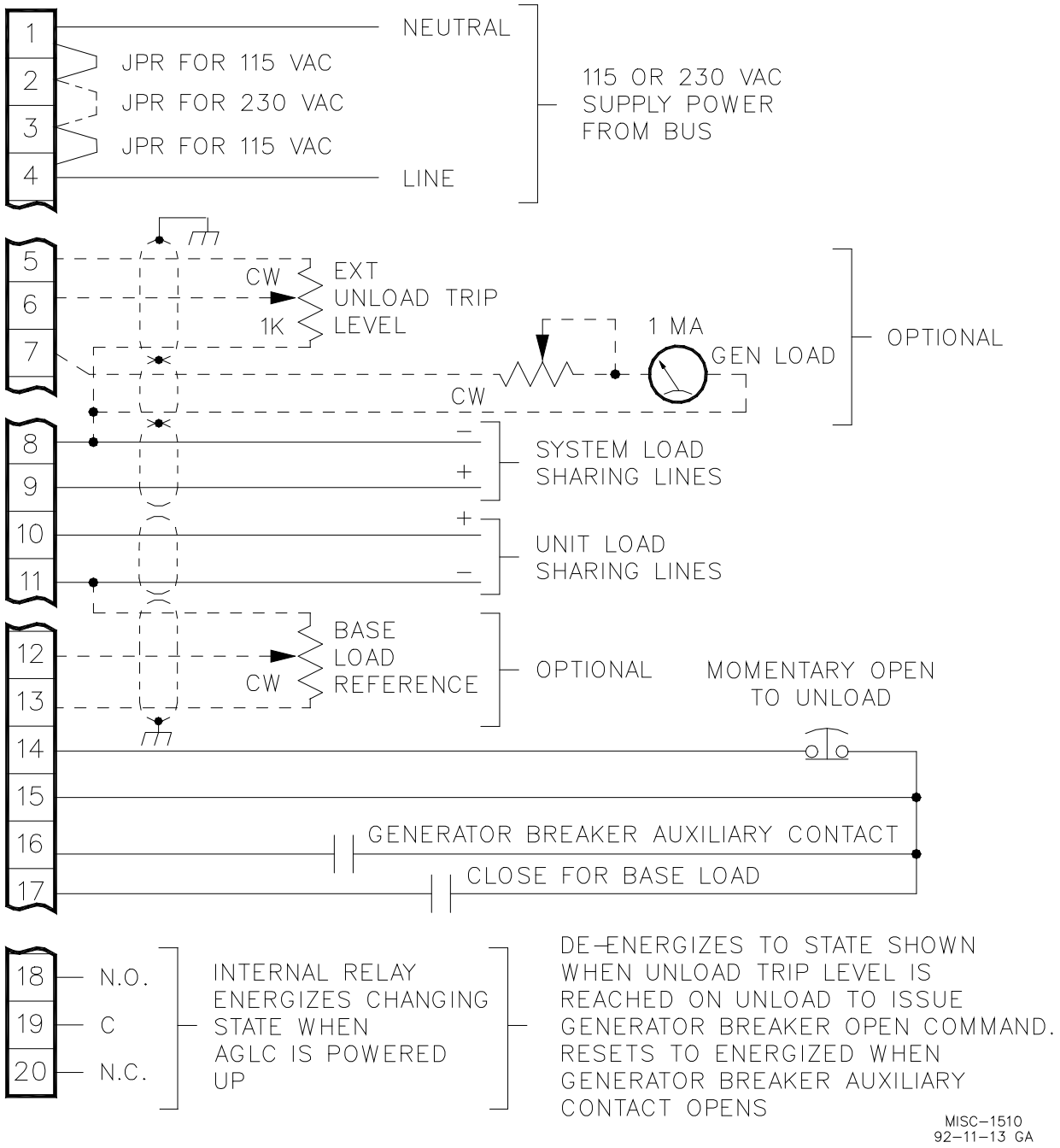


Figure 4-1. AGLC Control Plant Wiring

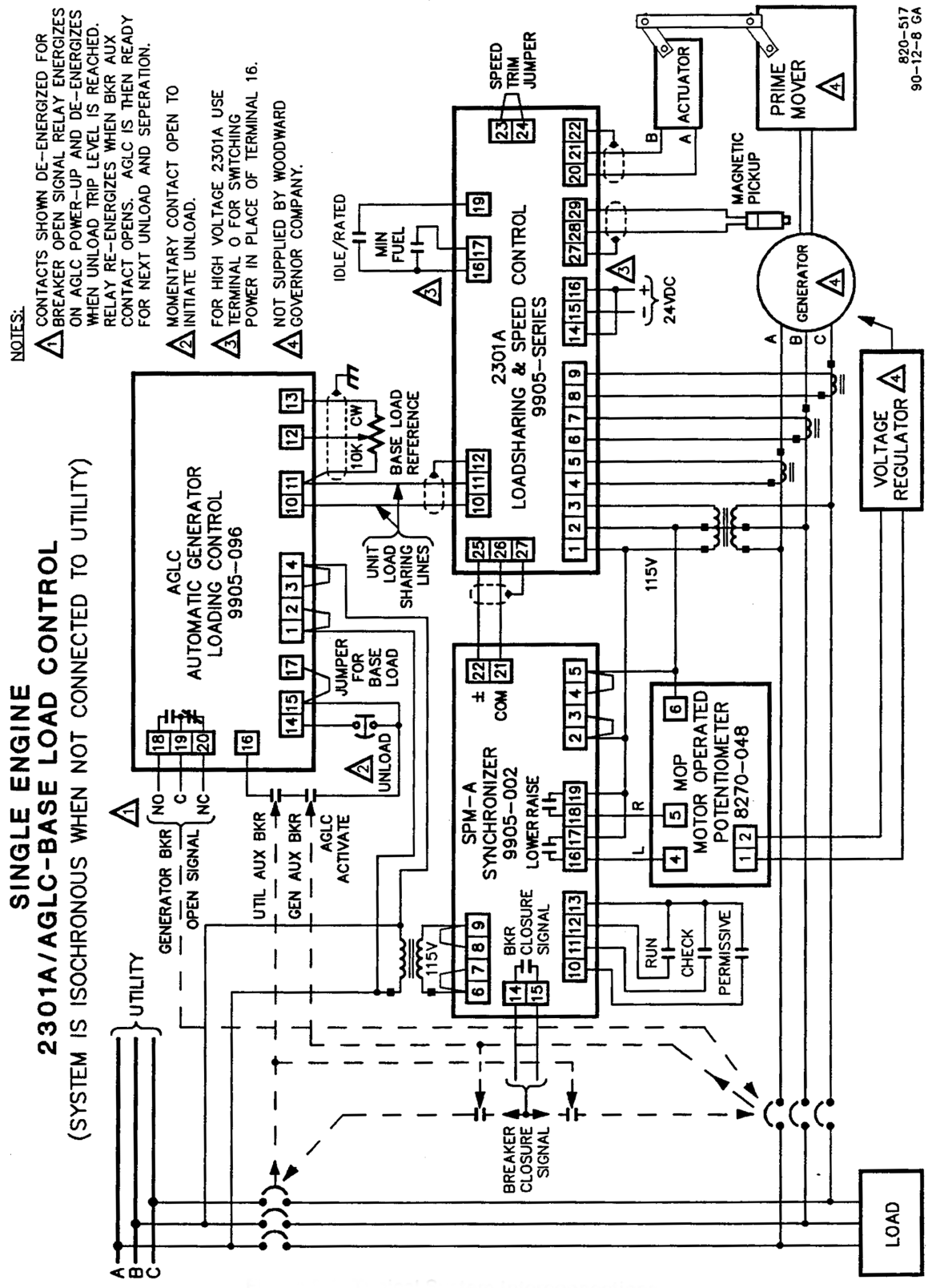


Figure 4-2. Typical System Interconnections

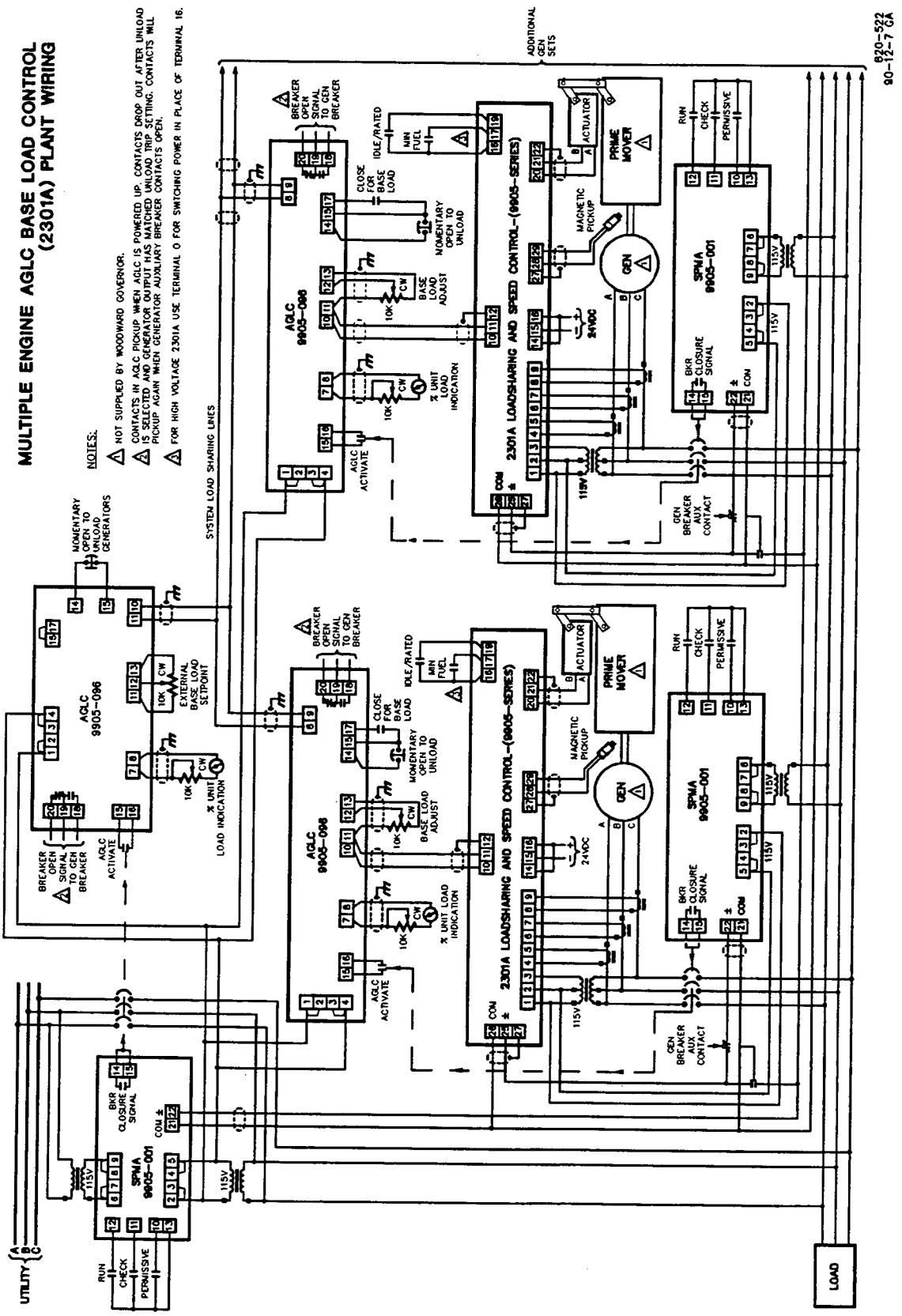


Figure 4-3. Plant Wiring for Multiple Engine AGLC Base Load Control (2301A System)

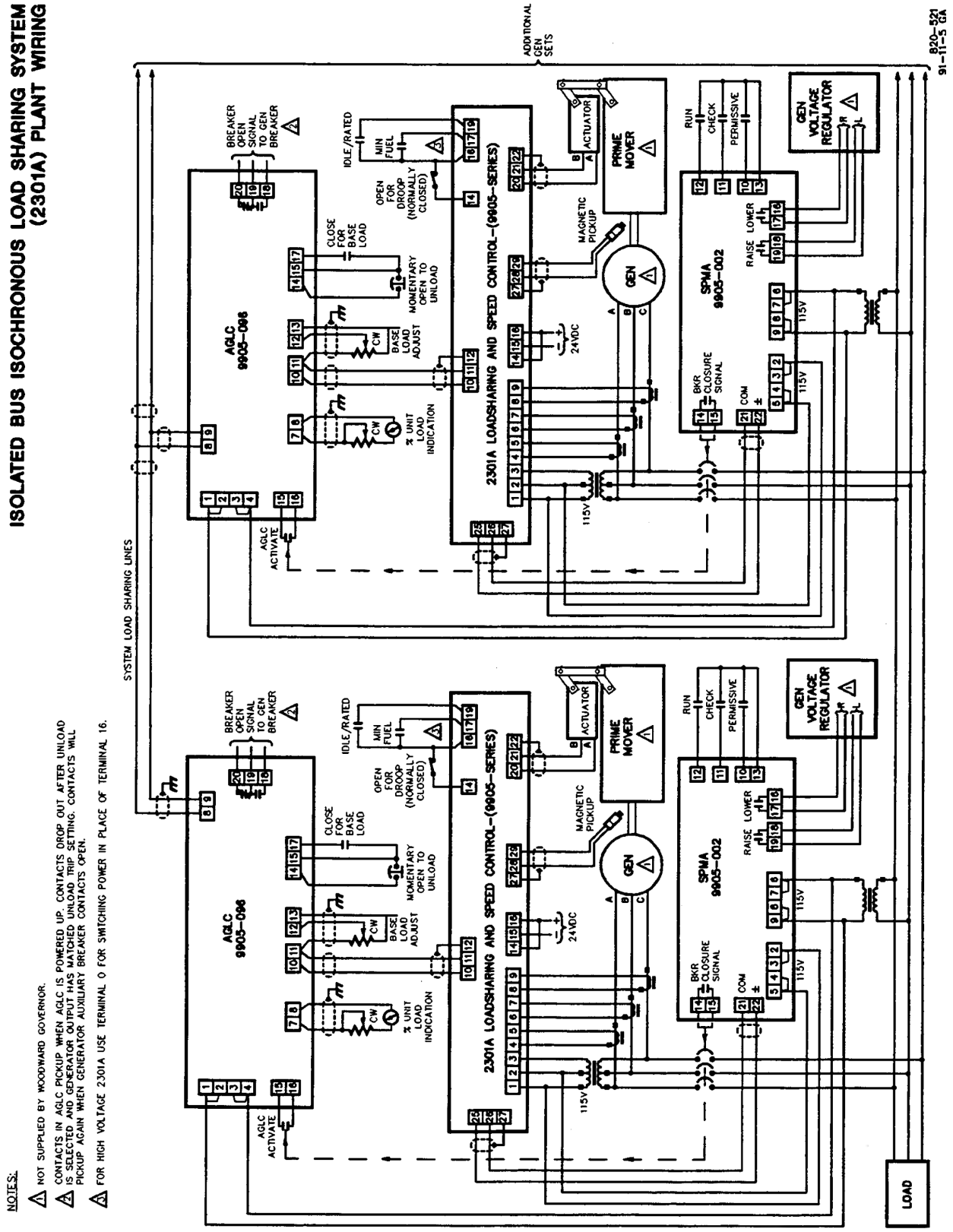


Figure 4-4. Plant Wiring for Isolated Bus System with AGLC and 2301A

Chapter 5. Troubleshooting

Introduction

When the AGLC is properly installed and the two ramp rates, unload trip, and the base load points have been established, operation is totally automatic. When the breaker closes, the auxiliary contacts activate the AGLC and the oncoming generator or generator system is loaded at a controlled rate. When the unload switch is opened momentarily, the controlled unit will unload to the trip point and, when the unload trip point is reached, signal the breaker to open. When the generator is paralleled with the utility and the base-load contacts are closed, the unit will ramp up or down to the base-load setting.

Troubleshooting

The following procedure is provided to permit bench testing of AGLC functions. All adjustments are accessible through the cover. The cover will not have to be removed for these tests. The complete control must be returned to the factory for any repair.

The bench test requires that ramp rates and set points be preset. The bench test should not be attempted unless the AGLC is suspected as the cause of control system problems.

IMPORTANT

Inspect all other portions of the control system and inspect all of the AGLC plant wiring and connections before determining that system problems are related to the AGLC. Take particular care while inspecting the system wiring to be sure that all shields are in place and properly grounded according to installation instructions.

Bench Test Tools

The following tools will be needed to conduct the bench test:

- High impedance multimeter
- Potentiometers and switches as shown in the plant wiring diagram, and 115 or 230 Vac power supply

AGLC Bench Test

This test may be used to check the AGLC for suspected malfunction.

Test Setup Procedure

1. Connect control inputs and outputs as shown on the plant wiring diagram. Connect all switch contacts and external potentiometers as indicated.

2. Preset the Unload and Load ramp-time potentiometers to full counterclockwise.

3. Preset the Unload Trip Level potentiometer full counter clockwise.

4. Preset the Base Load Limit potentiometer to mid position.

5. Preset the Base Load Reference potentiometer full clockwise.

6. Measure infinite resistance between all terminals and the chassis.

Power Supply Test

1. Jumper terminal 1 to terminal 2 and terminal 4 to terminal 3. Then connect 115 Vac to terminals 1 (line) and 4 (Neutral) of the AGLC. Open terminals 14 and 15.

2. Use a high-impedance voltmeter to read 26 ±6 Vdc between 14 (+) and 15 (–).

3. Use a high-impedance voltmeter to read +3.0 ±0.3 Vdc between terminals 5 (+) and 8 (–).

4. Use a high-impedance voltmeter to read –6.2 ±0.6 Vdc between terminals 15 (+) and 8 (–).

NOTICE

The AGLC contains parts that are static-sensitive. To prevent damage to these parts, discharge body static before handling the control (touch a grounded surface and maintain contact while handling the control). Avoid all plastic, vinyl, and styrofoam around the control if the circuit board is exposed.

Operational Tests

1. Power down and read infinite resistance between terminals 18 and 19, and zero resistance between terminals 19 and 20.

2. After power-up, read zero resistance between terminals 18 and 19, and infinite resistance between terminals 19 and 20. Close terminals 14 and 15.

3. Close the contact for BASE Load Reference 17 and 15.

4. Close the circuit breaker auxiliary contact 16 and 15.

5. Read zero resistance between terminals 18 and 19.

6. Read infinite resistance between terminals 19 and 20.

7. Adjust the Base Load Limiter potentiometer for a 4 Vdc reading at terminals 13 (+) and 11 (–). Note that the External Base Load Reference potentiometer must be full clockwise. Voltage at 10 (+) and 11 (–) will ramp to this value.

8. Adjust the External Base Load Reference potentiometer for 3 Vdc at terminals 12 (+) and 11 (–). Voltage at 10 (+) and 11 (–) will ramp to this value.

9. Set the unload trip level by measuring voltage between terminals 6 (+) and 8 (–). Adjust the Unload Trip Level potentiometer for 1 Vdc between terminals 6 (+) and 8 (–).

10. Momentarily open the switch between 14 and 15 (Momentary Open to Unload). Monitor voltage at terminals 10 (+) and 11 (–). This voltage will ramp down to the unload trip level voltage set in Step 9. When at the unload trip level, resistance between 18 and 19 should be infinite. Resistance between 19 and 20 should be zero.

IMPORTANT

After the AGLC is put back into the system, the unload trip level must be readjusted. To do this, measure the voltage between terminals 6 and 7. Set the Unload Trip Level potentiometer for 0 Vdc between terminals 6 and 7 to trips at 0 kW.

11. Open contacts between terminals 17 and 15. Then apply 3.02 Vdc at terminals 9 (+) and 8 (–). Open and close the Circuit Breaker Auxiliary contact between 16 (+) and 15 (–). Record the time for the voltage at terminals 10 (+) and 11 (–) to go from 0 to 3.0 Vdc. The voltage across 10 (+) and 11 (–) should increase to 3.0 Vdc in 5 seconds.

12. Vary the input voltage at terminals 9 (+)and 8 (–) between 0 and 3 Vdc. Observe the voltage at terminals 10 (+) and 11 (–) follow the input voltage. Leave the voltage at 3 Vdc.

13. Open and close the contact between terminals 14 and 15. Observe the voltage at terminals 10 (+)and 11 (–) go to 0 volts in 5 seconds.

14. Set the Unload and Load Ramp Time potentiometers full clockwise.

15. Open and close the Circuit Breaker Auxiliary contact at terminals 16 and 15. Observe the voltage at terminals 10 (+)and 11 (–) go to 3.0 Vdc in more than 5 minutes.

16. Open and close the Unload contacts between terminals 14 and 15. The voltage at terminals 10 (+) and 11 (–) should go to zero in more than 5 minutes.

Repeat steps 14 and 15 until the ramp rates are adjusted to suit the individual installation.

This completes the bench test of the AGLC. Should any portion of the AGLC fail the test, the unit must be returned to Woodward for repair or replacement. If all essential portions of the test were completed successfully, the AGLC is operationally sound and can be installed in the control system according to the installation, plant wiring, and adjustment instructions. Calibration must be completed after AGLC is installed in a generator control system.

Chapter 6.
Product Support and Service Options

Product Support Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email (**EngineHelpDesk@Woodward.com**) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

OEM or Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full-Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available at **www.woodward.com/directory**.

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who needs immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime.

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option, with the exception that the unit will be returned to you in “like-new” condition. This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:

- return number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:

- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Replacement Parts

When ordering replacement parts for controls, include the following information:

- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact.

Product Training is available as standard classes at many Distributor locations. Customized classes are also available, which can be tailored to your needs and held at one of our Distributor locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact one of the Full-Service Distributors listed at **www.woodward.com/directory**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **www.woodward.com/directory**, which also contains the most current product support and contact information.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used in Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used in Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used in Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number

Prime Mover Information

Manufacturer _____

Engine Model Number _____

Number of Cylinders _____

Type of Fuel (gas, gaseous, diesel, dual-fuel, etc.) _____

Power Output Rating _____

Application (power generation, marine, etc.)

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Symptoms

Description _____

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

Revision History

Changes in Revision D—

- Changed part number on cover to 9903-545
- Added part number 9903-545 reference to Regulatory Compliance Section

Changes in Revision C—

- Updated Power Supply Test (page 22)

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

Released

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 82004.

B 8 2 0 0 4 : D

PO Box 1519, Fort Collins CO 80522-1519, USA
1041 Woodward Way, Fort Collins CO 80524, USA
Phone +1 (970) 482-5811

Email and Website—www.woodward.com

Woodward has company-owned plants, subsidiaries, and branches, as well as authorized distributors and other authorized service and sales facilities throughout the world.

Complete address / phone / fax / email information for all locations is available on our website.