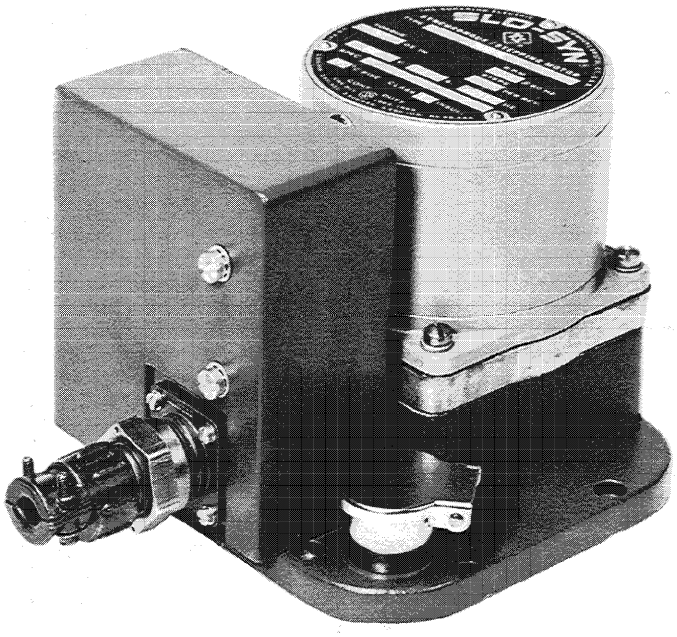
WOODWARD

Product Manual 03027
(Revision B)
Original Instructions



Synchronous/Stepping Speed Adjusting Motors for UG Governors

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 *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications page* of the Woodward website:

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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 *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, 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 Out-of-date translations are marked with ⚠.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.

Warnings and Notices

Important Definitions

This is the safety alert symbol. It is 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.

Synchronous/Stepping Speed Adjusting Motors for UG Governors

General Information

The motor most often used for speed adjusting or synchronizing purposes on Woodward engine and turbine controls is the Bodine V10R motor with integral worm gear speed reducer (see manual 03505). Its European equivalent is the Groschopp KM 58-20 motor.

For special applications however, another type of motor is available: the Slo-Syn synchronous/stepping motor. Main characteristics of this motor type are:

- Suitable for continuous operation
- Precise variable speed
- Motor electrically locked in position
- Instant starting and stopping
- Permanent stalling
- Easy to interface with any type of electronic control system

This manual describes the operating principles and maintenance of these motors.

Description

Slo-Syn synchronous stepping motors are permanent magnet motors available for ac constant speed or dc stepping applications.

The ac models have a speed synchronous with line frequency and can also be operated as dc stepping motors in simple stepping applications.

More demanding stepping applications require a motor specifically designed for this mode of operation and a properly designed electronic drive circuit.

AC Synchronous Motors

The ac synchronous motors are available for 110 and 220 V and have extremely rapid starting, stopping, and reversing characteristics. Shaft speed, synchronous with line frequency, is 72 rpm at 60 Hz and 60 rpm at 50 Hz. The motors require a single pole, three-position switch to provide forward, reverse, and “off” control.

When operating from a single phase source, a phase shifting network consisting of a resistor and a capacitor is also required.

On most governors, where ample space is available, the network components are integrally mounted on the cover together with the motor, so only the three-position switch is required to operate this motor. Where no place on the governor is available, the components are delivered separately and are to be mounted externally in the switchboard. Values of the phase shifting components depend on voltage, frequency, and type of motor. Figure 1 shows a typical wiring layout. For most speed adjusting purposes on UG governors, the Slo-Syn motor can be provided with a planetary gearbox reducing the shaft speed to 0.55 rpm, 2.77 rpm, or to 13.85 rpm at 50 Hz. The resulting speed adjusting rate is dependent on the parameters of the governor on which the motor is used, so no pertinent figures can be given in this manual. The permanent magnet construction of the motor provides a small residual torque which holds the shaft in position and thus the governor at the required speed setting when the motor is de-energized. However, should the motor tend to rotate due to engine vibrations, a much greater holding torque can be obtained by applying a dc voltage to the windings when the ac input is removed. A typical wiring diagram is shown in Figure 2. Voltage and current requirements are 50 Vdc and 0.15 A for 120 Vac motors, and 100 Vdc and 0.08 A for 240 Vac motors.

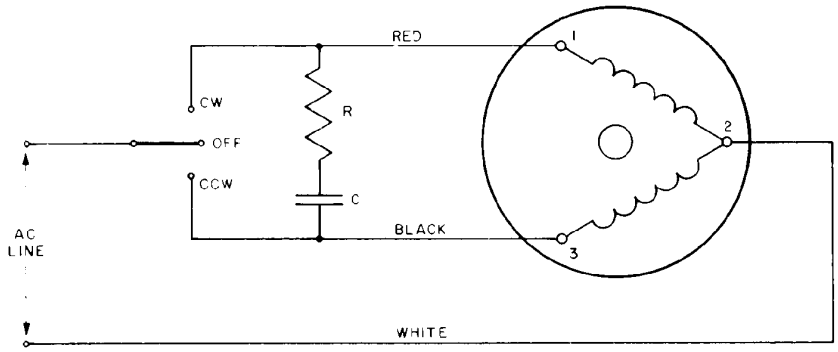


Figure 1. Typical Wiring Layout

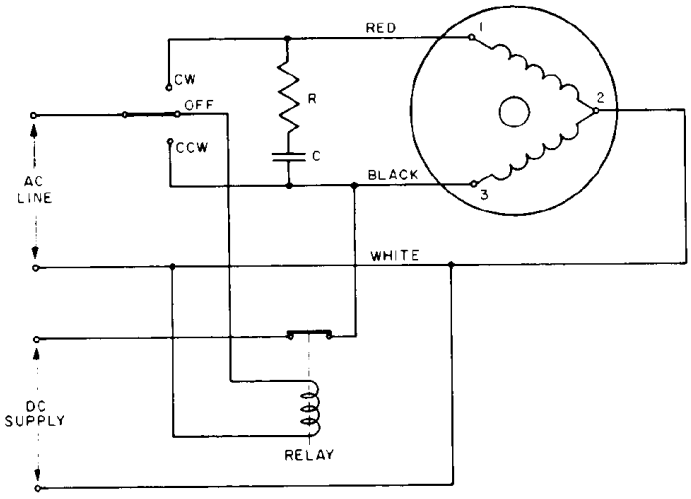


Figure 2. Typical Wiring Diagram

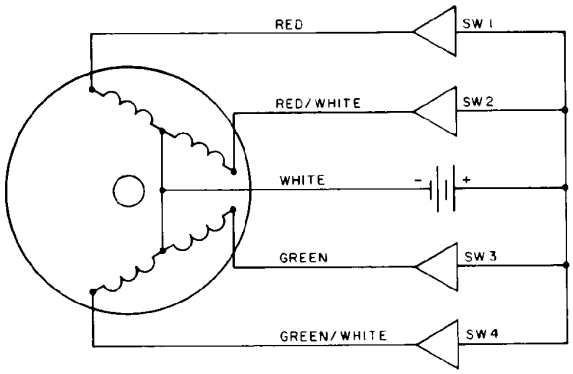
The standard ac motors are fully potted for the best possible vibration resistance.

They are rated for continuous duty at a maximum ambient temperature of 60 °C (140 °F). Motor shell temperature must not exceed 90 °C (194 °F). All motors have class B insulation.

DC Stepping Motor

When only a dc supply is available, or when an accurate, variable rate of speed change is needed, a dc stepping motor is used. Although the three-wire ac motor can also be used for stepping purposes, the special bifilar dc motor provides a greater torque and higher stepping rate. They are built basically the same as ac motors, with permanent magnet rotor and 8-pole stators, but with 5 motor leads instead of 3.

Figure 3 shows the schematic dc stepping circuit. When switched in the four-step mode as shown, one step is 1.8°. As a result, one shaft revolution requires 200 steps.



STEP	SW 1	SW2	SW3	SW4
1	ON	OFF	ON	OFF
2	ON	OFF	OFF	ON
3	OFF	ON	OFF	ON
4	OFF	ON	ON	OFF
1	ON	OFF	ON	OFF

Figure 3. Schematic DC Stepping Circuit

Power transistors connected to flip-flops or other logic devices are normally used for switching. Since current is maintained on the motor windings when the motor is not being stepped, a high holding torque results.

Bifilar stepping motors are used as speed adjusting motors by Woodward for its synchrophasing installation and for its load sharing equipment.

For variable speed adjusting purposes, an electronic speed-setting unit in available, driving the motor from a 24 Vdc power source at a variable rate (see manual 82454).

Information and Parts Replacement

When requesting information concerning motors or when ordering spares, it is essential that following information accompany the request:

- Serial number of the governor
- Woodward number of the motor (engraved in the nameplate of the motor)
- Manual number (this is manual 03027)

Since the synchronous stepping motor has a permanent magnet rotor, disassembly and removal of this rotor from the stator will reduce the magnetic flux and thus the torque of the motor by approximately 30%. It is, therefore, recommended not to disassemble the motor in case of failure, but to replace the complete motor.

The rotor bearings, being of the double-shielded type, need no lubrication. The stator windings are fully potted. As a result no part numbers for motor parts are given in this manual.

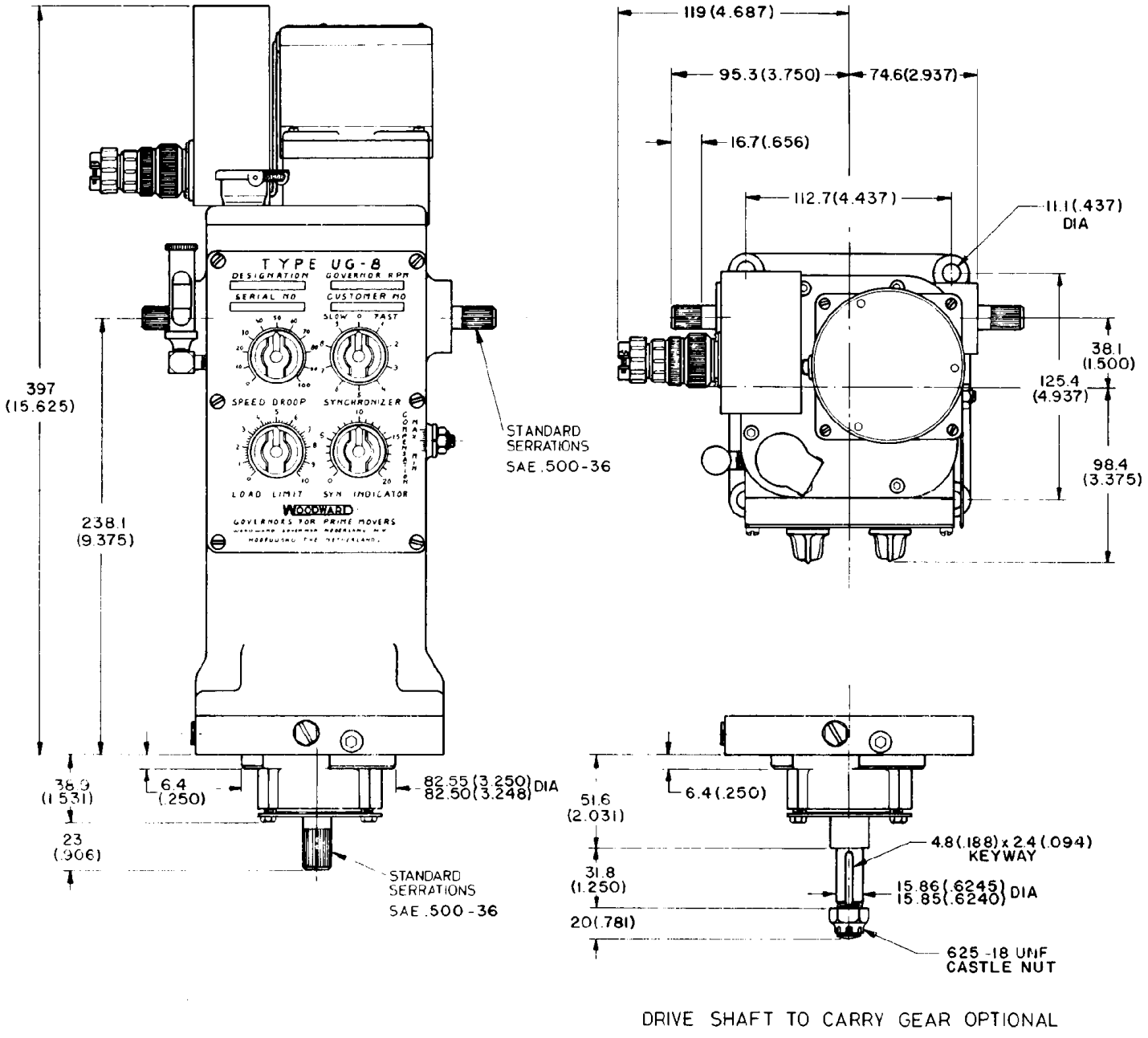


Figure 4. UG-8 Governor with Motor

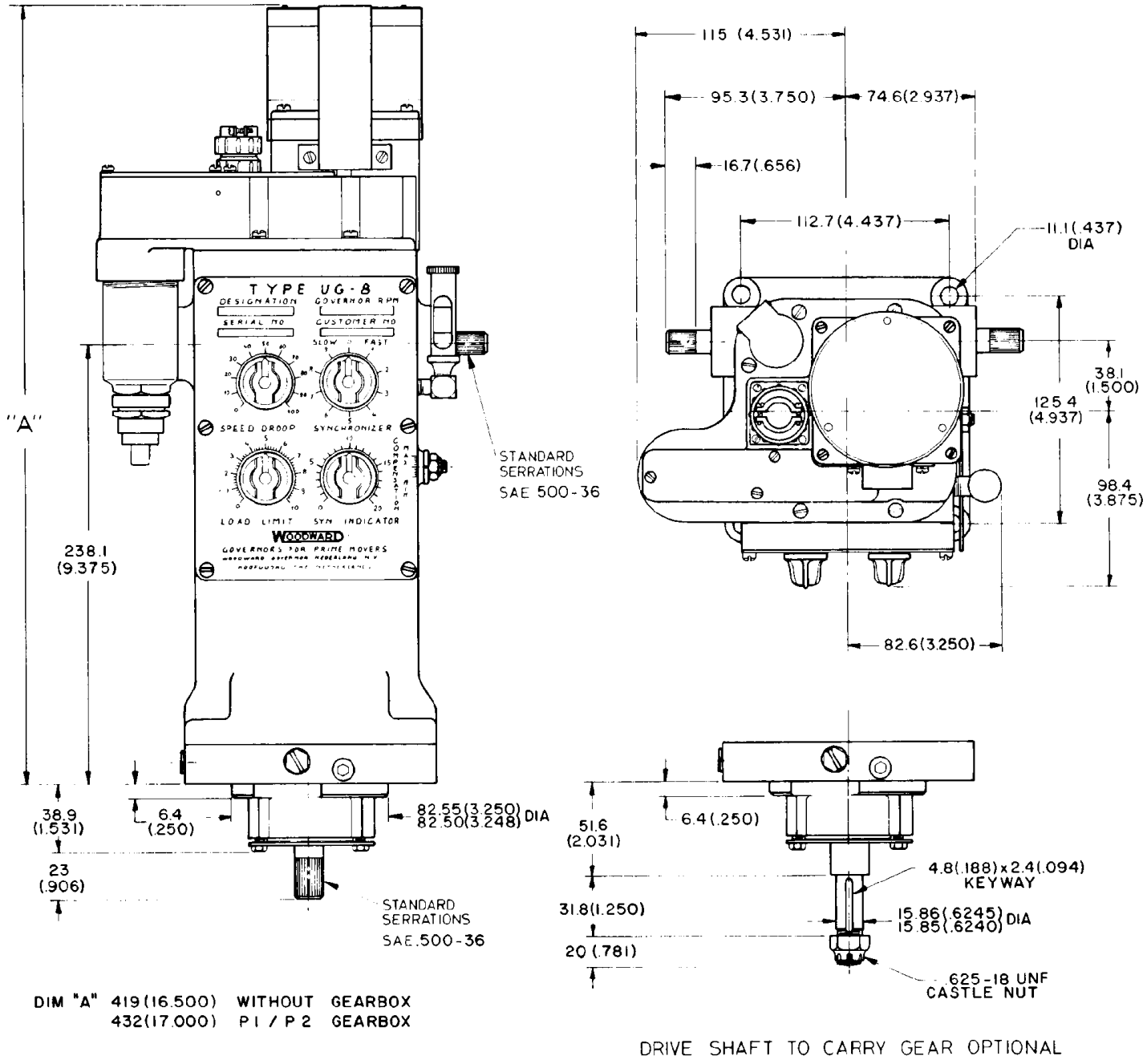


Figure 5. UG-8 Governor with Motor

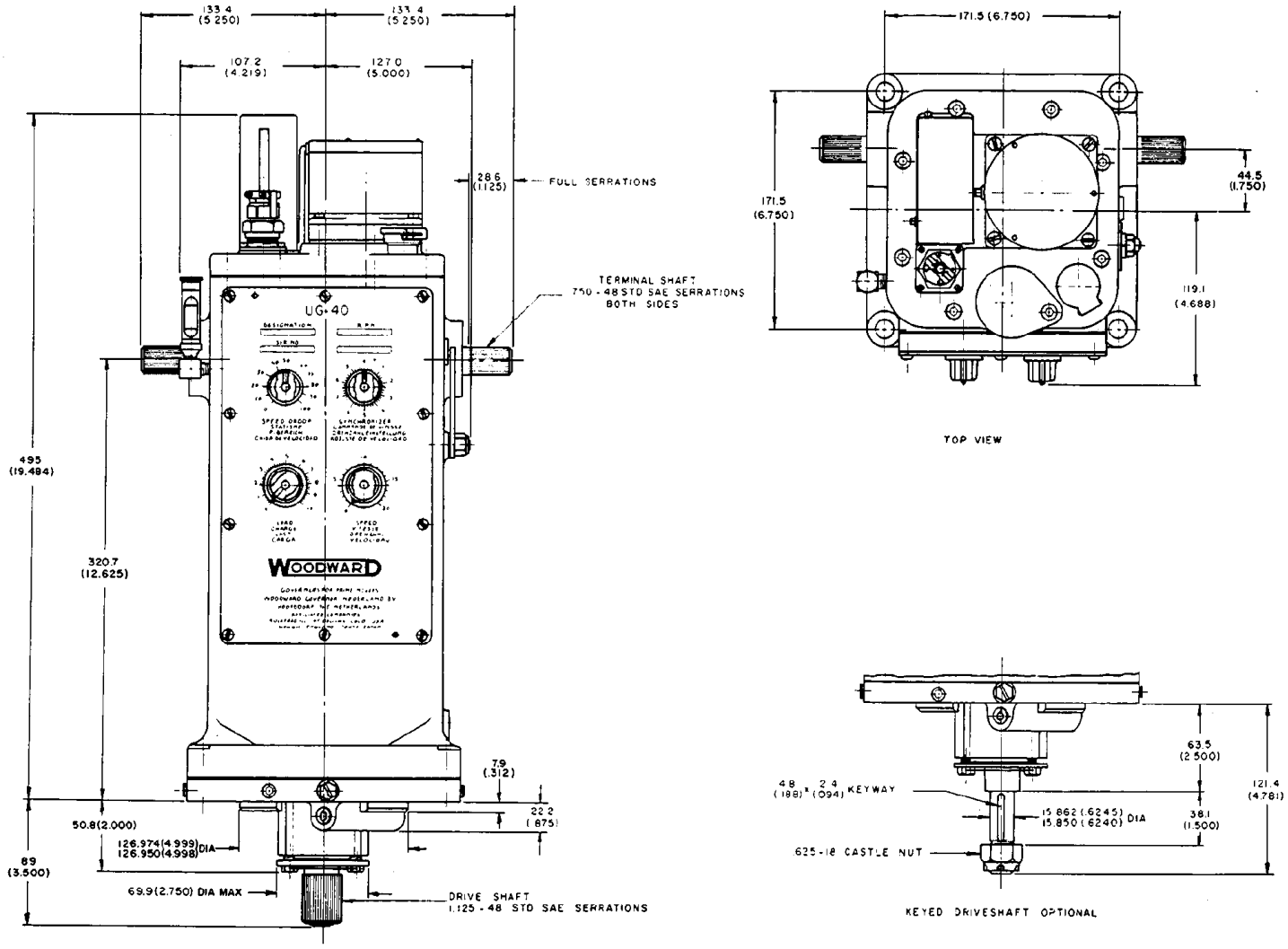


Figure 6. UG-40 Governor with Motor

WOODWARD

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