WOODWARD

Product Manual 82389
(Revision U, 7/2016)
Original Instructions

2301A Electronic Load Sharing and Speed Control

9905/9907 Series
CSA Certified LR46653

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:

www.woodward.com/publications

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 Out-of-date translations are marked with ⚠.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—Changes in this publication since the last revision are indicated by a black line alongside the text.

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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.

Regulatory Compliance

European Compliance for CE Mark
These listings are limited only to those units bearing the CE Marking.

Low Voltage Directive:	Directive 2014/35/EU on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits
EMC Directive:	Declared to Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC)

North American Compliance

CSA:	CSA Certified for Ordinary Locations for use in the United States and Canada.

Control Specifications

General Specifications

Power Supply Rating	90–150 Vdc or 85–132 Vac for High Voltage models 20–40 Vdc for Low Voltage models
Power Consumption	less than or equal to 15 W nominal
Inputs—	
Load Sensing	90–240 Vac 3ø 45–66 Hz 3ø current transformer input
Speed Sensor Input Impedance	100–300 Ω
Speed Sensor	magnetic pickup 1.0 Vac minimum to 30 Vac maximum
Speed Trim	0–100 Ω for 0 to 10% speed change
Speed Setting	terminals 23–24 jumpered, internally adjustable 100 Ω potentiometer allows external 0–10% speed trim
Idle Speed Select	external switch, open terminals 19 to 16
Droop	external switch, open terminals 14 to 16
Synchronizer	±5 Vdc for speed change with Woodward SPM-A synchronizer
Load Sharing	0–6 Vdc
Outputs—	
Actuator	7.5 Vdc max for 0 to 214 mA with 35 Ω coil
Adjustments—	
Rated Speed	11 450 Hz
Acceleration Ramp (±Idle to Rated)	0–10 s, switch activated, close terminals 19 to 16
Actuator Compensation	time constant compatibility 0–500 ms
Low Idle Speed	55% rated
Load Gain	6 Vdc maximum at 5 A CT current
Droop	0 to 10%
Speed Control Range	switch selectable, 500–1500 Hz, 1000–3000 Hz, 2000–6000 Hz (standard), 4000–12 000 Hz
Operating Temperature	–40 to +85 °C (–40 to +185 °F)
Load Sharing	±5% of rated load with speed setting matched
Vibration	4 Gs, 5 to 500 Hz
Shock	60 Gs
Weight	approximately 1.8 kg (4 lb)
Finish	gloss powder

Chapter 1.
General Information

Description

The 9905/9907 series of the Woodward 2301A controls load sharing and speed of generators driven by diesel or gasoline engines, or steam or gas turbines. These power sources are referred to as “prime movers” throughout this manual.

The control is housed in a sheet-metal chassis and consists of a single printed circuit board. All potentiometers are accessible from the front of the chassis.

The 2301A provides control in either isochronous or droop mode.

The isochronous mode is used for constant prime mover speed with:
- Single-prime-mover operation;
- Two or more prime movers controlled by Woodward load sharing control systems on an isolated bus;
- Base loading against an infinite bus with the load controlled by an Automatic Power Transfer and Load (APTL) Control, an Import/Export Control, a Generator Loading Control, a Process Control, or another load-controlling accessory.

The droop mode is used for speed control as a function of load with:
- Single-prime-mover operation on an infinite bus or
- Parallel operation of two or more prime movers.

The following is an example of the typical hardware needed for the 2301A system controlling a single prime-mover and generator:
- A 2301A electronic control
- An external 20 to 40 Vdc power source for low-voltage models; 90 to 150 Vdc or 88 to 132 Vac for high-voltage models
- A proportional actuator to position the fuel-metering device, and
- Current and potential transformers for measuring the load carried by the generator.

Applications

The 2301A 9905/9907 series electronic controls have switch-selectable speed ranges. Any of these control models can be set to operate within one of the following rated speed ranges:
- 500 to 1500 Hz
- 1000 to 3000 Hz
- 2000 to 6000 Hz
- 4000 to 12 000 Hz

⚠WARNING

The speed range is factory set for 2000 to 6000 Hz. Refer to the inside cover to change speed range and prevent possible overspeed. Using the wrong speed range could cause an overspeed with resulting damage to equipment and/or personal injury or death.

NOTICE

The Rated Speed potentiometer is the only multi-turn pot in this control. All other pots are single-turn. Take care not to turn these pots beyond their stops.

These controls are available for forward- or reverse-acting applications, and for use with either single or tandem actuators. Models for three different actuator current ranges are available, as well as a high-voltage model (90 to 150 Vdc or 88 to 132 Vac, 45 to 440 Hz), and a low-voltage model (20 to 40 Vdc). The high voltage model is identified as such on the front; the low voltage model is not.

In reverse-acting systems, the actuator calls for more fuel when the actuator voltage decreases. Complete loss of voltage to the actuator will drive the actuator to full fuel. This allows a backup mechanical ballhead governor to take control rather than shut down the prime mover as would a direct-acting system.

An optional deceleration ramp is also offered. When this option is present, the time to ramp from rated speed to idle speed is approximately 20 seconds. If this option is not present, this happens instantly.

Tables 1-1 and 1-2 show part numbers and features of all 9905/9907 series 2301A load sharing and speed controls.

IMPORTANT **External wiring connections for reverse-acting controls are identical to those for direct-acting controls.**

The relationship between prime mover speed and sensor output frequency is expressed in the formula:

Sensor Frequency in Hz equals the number of teeth on the speed sensing gear times the rated prime mover speed in revolutions per minute divided by 60.

Application engineers from Woodward or any of its authorized distributors or agents are always available to assist you in selection of the correct control for your system, or to answer questions concerning control installation, operation, or calibration. See Chapter 6 for contact information.

References

The following publications contain additional product or installation information on Load Sharing and Speed Controls, and related components. They are available on the Woodward website (**www.woodward.com/ic**).

technical manual	**title**
25070	*Electronic Governor Installation Guide*
26260	*Governing Fundamentals and Power Management*
82384	*SPM-A Synchronizer 9905-002*
82510	*Magnetic Pickups & Proximity Switches for Electronic Controls*
82715	*Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*

product specification	**title**
82383	*SPM-A Synchronizer*
82390	*2301A Load Sharing and Speed Controls (9905 Series)*
82516	*EG3P/6P/10P Actuator*
82575	*EGB1P/2P Governor/Actuator*

2301A Load Sharing and Speed Control Models, 9905/9907 Series

Table 1-1. Low-Voltage 2301A Models (20 to 40 Vdc)

Part Number	Actuator Current (mA)	Forward/ Reverse Acting	Actuator Tandem/Single	Decel Ramp
9905-020	0–200	Forward	Single	No
9905-021	0–200	Reverse	Single	No
9905-022	0–400	Forward	Single	No
9905-023	0–400	Reverse	Single	No
9905-024	0–200	Forward	Tandem	No
9905-025	0–200	Reverse	Tandem	No
9905-026	0–20	Forward	Single	No
9905-027	0–20	Reverse	Single	No
9905-028	0–200	Forward	Single	Yes
9905-029	0–200	Reverse	Single	Yes
9907-018 *	0–200	Forward	Single	No
9907-019 *	0–200	Reverse	Single	No
9907-023 *	0–200	Forward	Single	No
9907-024 *	0–200	Reverse	Single	No

*—CE Approved models

Table 1-2. High-Voltage 2301A Models (88–132 Vac or 90–150 Vdc)

Part Number	Actuator Current (mA)	Forward/ Reverse Acting	Actuator Tandem/Single	Decel Ramp
9905-030	0–200	Forward	Single	No
9905-031	0–200	Reverse	Single	No
9905-032	0–400	Forward	Single	No
9905-033	0–400	Reverse	Single	No
9905-034	0–200	Forward	Tandem	No
9905-035	0–200	Reverse	Tandem	No
9905-036	0–20	Forward	Single	No
9905-037	0–20	Reverse	Single	No
9905-038	0–200	Forward	Single	Yes
9905-039	0–200	Reverse	Single	Yes

IMPORTANT

The 20–40 Vdc input power must be supplied from a power supply/battery charger certified to IEC standard with SELV (Safety Extra Low Voltage) classified output. The installer should properly size wiring and fusing for the input power and PT/CT circuits.

Speed Ranges

On these Woodward 2301A models, any one of the following speed ranges may be selected by a switch:

500 to 1500 Hz	1000 to 3000 Hz
2000 to 6000 Hz	4000 to 12 000 Hz

Power Supply Voltage

These Woodward 2301A controls accept either a high-voltage or a low-voltage power source. The low voltage models operate on 20 to 40 Vdc, and the high voltage models operate on either 88 to 132 Vac or 90 to 150 Vdc. Both the low- and high-voltage models require a power capacity of 15 W minimum.