WOODWARD

Product Manual 55016
(Revision NEW)
Original Instructions

2301 Speed Loop Test Box with Load Sensor Test

T96571

Operation Manual

IMPORTANT

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.

DEFINITIONS

- **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

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.

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.

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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.

NOTICE

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.

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*.

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Chapter 1.
General Information

Introduction

The Woodward Model T-96571 Portable Speed Loop Test Box (Figure 1-1) is a compact, versatile, easy-to-use electronic instrument that simulates most diesel engines. You can use it to test 2301 and 2500, and Speed Loop systems with proportional actuator simulation. Among the many features this 2301 Speed Loop Test Box offers are:

- Actuator simulation of 2301 controls.
- Magnetic Pickup (MPU), the speed output signal.
- Loading capabilities, for increasing required actuator voltage or upsetting the null voltage.
- Engine acceleration, to approximate the Test Box response to the control under test.
- Load Sensor Test capabilities, Potential Transformer (PT) and Current Transformer (CT) simulations.
- Start function, to overcome an activated failsafe circuit in the control under test.
- Actuator voltage meter, to measure the voltage across the simulated actuator (35 Ω resistor).
- Signal generator mode of operation, to allow the checking of switch points or control set points.
- Digital Frequency Meter, for the exact setting of speed.
- 24 V power supply, to power the control under test (2301 types only).

Specifications

Line Input	115 or 230 Vac (switch selectable) 50 or 60 Hz
Power Supply	24 Vdc 350 mA max.
Actuator Input	0–200 mA max.
Actuator Input Resistance	35 Ω
Magnetic Pickup Output	4.0 Vrms at 4800 Hz
Magnetic Pickup Range	0–19 kHz
Actuator Meter	0–10 Vdc ±2%
Digital Frequency Meter	19 999 ±1 Hz
SW 1 and SW 2	125 Vac @ 1 A max.
PT Voltages	*120/240 Vac L-L
CT Voltages	*1.5/3.0 Vac
CT Currents	*5 A @ 0.25 Ω burden resistor
	*5 A @ 0.50 Ω burden resistor

* Specify with order—factory installation

Principles of Operation

Introduction to the Block Diagram

The block diagram (Figure 1-2) provides an illustration of Test Box operation. The closed loop portion of the block diagram is divided into Actuator Simulation and Engine Simulation. The input signals are on the left, and the output signals are on the right.

Actuator Input Amplifier

The function of the input amplifier is to convert the current that is supplied from the control under test to the Test Box to a voltage that is scaled to equal minimum to maximum fuel input. A 35 Ω resistor is used to simulate the actuator coil and the 0–10 Vdc meter is used to monitor the voltage across it.

Actuator Response Amplifier

The response amplifier has input adjustments and selections from the front panel. The LEVEL is used, in the 2301 mode, to set the amount of actuator voltage needed to cause the Text Box to output an MPU signal.

Engine Start/Load Amplifier

The engine start/load amplifier has inputs from the actuator simulation (total fuel flow), LOAD ADJ, LOAD ON/OFF switch, and the START switch. The total fuel flow signal is positive and causes the output to increase. The START switch is also positive and when activated will cause the output to increase. The LOAD ADJ and the LOAD ON/OFF switch are negative inputs and will cause the output to decrease in voltage. This will look like a load on the engine and the control under test will increase actuator current to the Text Box.

Engine Response Amplifier

This amplifier controls the acceleration of the engine. The acceleration is defined as the percent per second change of rated engine speed. The front panel selector switch has three rates, 30%, 50%, and 100% per second. The output voltage (engine speed) Is proportional to MPU frequency.

MPU Oscillator/Speed Amplifier

The RANGE ADJUST, located on the front panel, scales the output from the engine response amplifier for the maximum MPU frequency desired. The MPU oscillator produces a sine wave. The MPU frequency out is proportional voltage in. The speed amplifier drives the output transformer. The MPU frequency is displayed on the digital to frequency meter and is scaled in Hertz.

Load Sensor Test Sequence

Potential transformer voltages and current transformer currents are selected one phase at a time by the LST rotary switch. The CT current is 5 A. But because of test lead and terminal strip connections, this may vary slightly.

⚠WARNING **HIGH VOLTAGE—When the DANGEROUS VOLTAGES indicator is on, voltages of up to 230 Vac are present at the PT output terminals!**

Power Supply-Control Under Test

The (±) 24 V terminal strip output is used to power the control under test when its requirements do not exceed a maximum of 350 mA (0.350 A). If the output terminals are shorted, fuse 1 will blow, but will not cause permanent damage to the power supply.

Power Supply–Test Box

The voltages are for internal use only and are used to power the Text Box's printed circuit board and the Digital Frequency Meter. All power supplies are fused by fuse 1.

Switches—SW1 and SW2

These miscellaneous function switches can be wired to the control under test to activate control requirements.

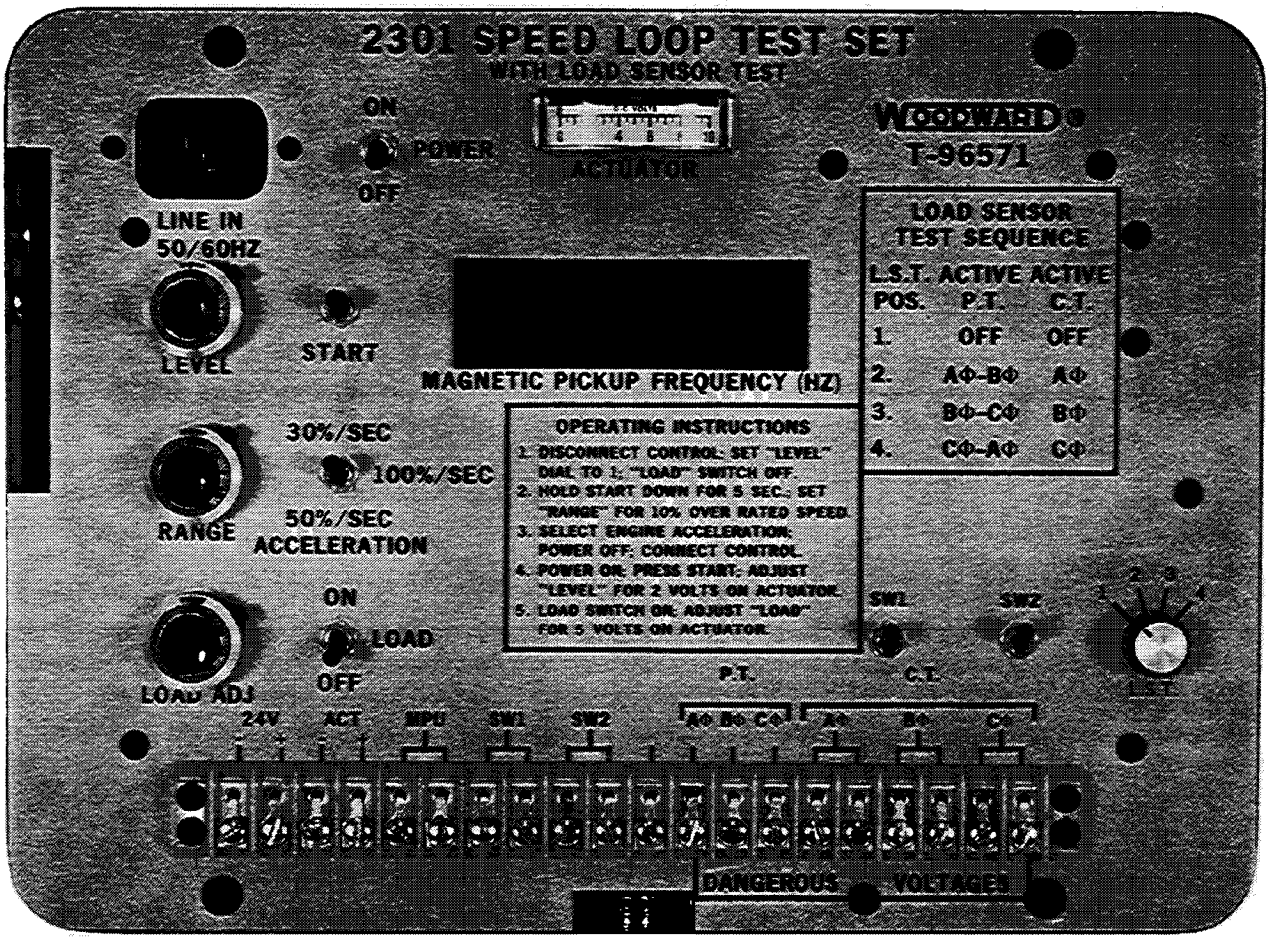

Figure 1-1. 2301 Speed Loop Test Box

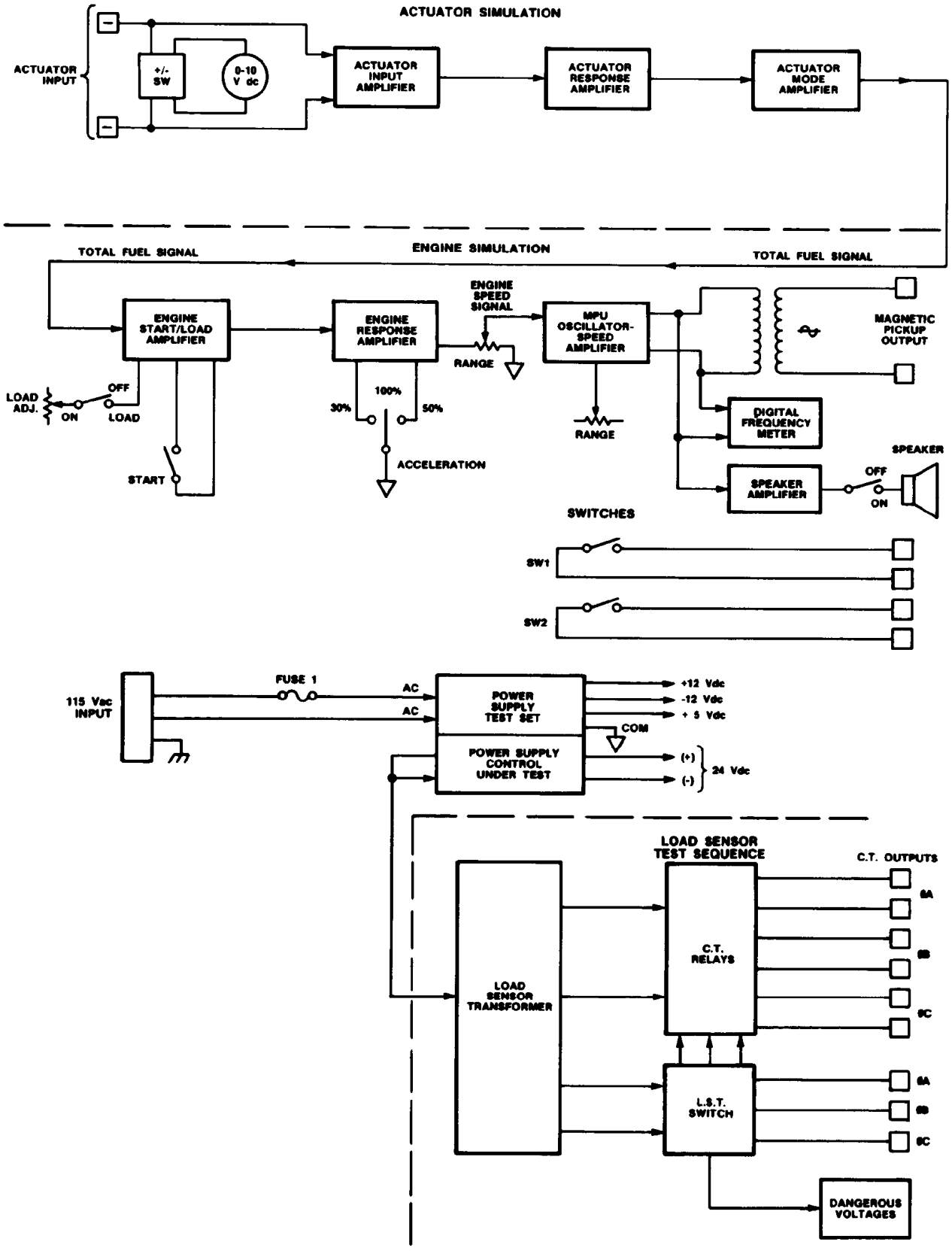

Figure 1-2. Text Box Block Diagram

Chapter 2.
Operating Procedures

Introduction

The following procedure is written to help you obtain the most use from your Portable Speed Loop Test Box, It covers the setup procedures for testing 2301 speed loop controls, open loop testing of Load Sensing systems, and a signal generator capability. This procedure is written with the assumption that the control under test is in working condition.

Setup Procedure—2301 Controls

1. Before connecting the control under test to the Test Box, make the following settings. Set the LEVEL switch to dial setting 1,. LOAD ADJ to 0, LOAD switch OFF, ACTUATOR meter switch (+), and the LST switch to position 1.

2. Place the POWER switch in the ON position, and hold the START switch down for five seconds.

3. Maintain the START switch in the down position, use the RANGE adjust to set the MPU frequency for 10% over rated speed. Maximum rated speed is determined from the specifications of the control under test.

4. Set the ACCELERATION switch for one of the three rates. The acceleration is the percent per second change of maximum MPU frequency with a change of actuator input voltage from minimum to maximum in one step.

5. Place the POWER switch in the OFF position.

6. Connect the control under test to the terminal strip of the Test Box. Use the plant wiring diagram for the specific control under test.

7. Place the POWER switch in the ON position and if the control under test has an active failsafe circuit, hold down the START switch momentarily.

8. When the control under test is controlling the speed of the Test Box, adjust the LEVEL for approximately 2 V on the ACTUATOR meter.

9. Place the LOAD switch in the ON position and set the LOAD ADJ for approximately 5 V on the ACTUATOR meter.

10. Adjust the control under test for the best stability and response of the system. The response is observed by watching the ACTUATOR meter.

Load Sensor Test Sequence

1. Place the POWER switch in the OFF position and the LST switch in position 1.

2. Connect the load sensor section of the control under test to the PT and CT terminals. The wires used for the CT connections should be 0.5 mm² (20 AWG) or larger.

3. Place the LST switch in positions 2, 3, and 4. The Test Box will output the proper sequence of line-to-line voltages and currents to test the control under test one phase at a time. The test sequence is listed below:

Position	Active PT	Active CT
1	OFF	OFF
2	AØ – BØ	AØ
3	BØ – CØ	BØ
4	CØ – AØ	CØ

WARNING

HIGH VOLTAGE—When the Load Sensor Test is not in use, return the LST switch to position 1. Make sure the DANGEROUS VOLTAGES indicator is off.

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Send comments to: icinfo@woodward.com

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