WOODWARD

Product Manual 25094
(Revision NEW)
Original Instructions

T-96046 Test Stand

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.

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, be sure to check the *publications page* on the Woodward website:

www.woodward.com/publications

The current revision and distribution restriction of all publications are shown in manual *26311*.

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.

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*.

Contents

Illustrations and Tables

Chapter 1.
Setup

Introduction

To set up the test stand, use the following procedure.

IMPORTANT **DO NOT apply power to any part of the test stand until step 4 is performed.**

1. Check for damage to the test stand.
2. Check for and install any loose boards.
3. Check for and install any loose cables.
4. Connect 115 Vac to the test stand.

IMPORTANT **Apply the input power only after all the boards and cables are installed and checked to be in their correct locations.**

Points to Remember

The following are important points that must be remembered whenever installing or removing the boards or cables inside the test stand:

1. DO NOT apply the input power until all the boards and cables in the test stand have been installed.
2. DO NOT install or remove a board or cable with the input power applied.
3. ALWAYS check that a board or cable is being installed in the correct location before trying to install it.
4. DO NOT force a board into a slot connector.
5. The component side of a board ALWAYS faces the back or the right side, viewed from the front of the test stand.
6. ALWAYS check that there are no obstructions before installing a board or cable.
7. DO NOT force the cable sockets (on the cables) into the into the cable connectors.
8. The cable sockets are numbered the same for both ends of the cable.
9. The cable sockets are numbered the same as the cable connectors.
10. The cable sockets and connectors are aligned correctly when the arrows imprinted on the cable sockets and connectors are lined up.

Removing Boards

To remove a board from the test stand card rack, use the following procedure.

1. Unplug the input power to the test stand.
2. Gently pull the board out of the slot.

Chapter 2. Calibration

Equipment Needed

Standards Items

- Calibrated current source, 0 to 200 mA
- ac/dc multimeter, calibrated (2)
- Two-channel oscilloscope
- Frequency counter
- Function generator

Other Equipment Needed

- Misc. sets of test leads
- Extender card
- 0.5 Ω, 25 W resistor
- Calibration patch*
- LED/source patch*
- Actuator function test patch*

* Listed at end of procedure

Pre-Calibration Procedure

1. Take the sides off the test stand.
2. Place switches 1 through 64 in the down position.
3. Zero all analog meters with the mechanical zero adjustment.

Power Supply Calibration Procedure

1. Install the calibration patch.
2. Measure the power supplies as follows:

Probe (-)	Probe (+)	Voltage	Tolerance	Adjust
Front Terminal Block	Tb2-17	Ground		
15	TB2-5	+15	±0.1 V	R17 DATEL
15	TB2-6	–15	±0.1 V	R30 DATEL
15	TB2-7	+10	±0.01 V	R1 ±10 V
15	TB2-8	–10	±0.01 V	R3 P.S.
15	TB2-9	+5	±0.1 V	R9 DATEL
15	TB2-10	+24	±0.1 V	R10 DATEL
15	TB2-11	+18	±0.1 V	R1 ±18 V
15	TB2-12	–18	±0.1 V	R3 P.S.
15	TB2-13	+34	±0.1 V	R1 ±34 V
15	TB2-14	–34	±0.1 V	R3

Actuator Calibration Procedure

IMPORTANT **Toggle switches 9 and 10 to turn on Actuator 1 and 2, respectively. DO NOT HAVE BOTH ON AT THE SAME TIME!**

1. Connect the Current Source between terminal 1(+) and terminal 2(-) of the terminal block on the front of the test stand.
2. Place the Integrate/Proportional switches in the Proportional position.
3. Place the Normal/Reverse switches in the Normal position.
4. Place the Dual Fuel/Extraction switch in the Dual Fuel position. Check that switches S1 and S2 on Actuator board are closed.
5. Place the Closed/Open switches for Actuator 1 and 2 in the Closed position. Put Actuator board on an extender card.
6. Set the Digital Meter Rotary Selector switch in the Actuator 1 position. Set Switch 9 ON.
7. Set the Current Source for 0 mA (0-200 mA scale).
8. The digital meter must read 000.0 ±0.1 mA. If not, adjust R11.
9. Set the Digital Meter Rotary Selector switch in the Actuator 2 position. Set Switch 9 Off, and Switch 10 on.
10. The digital meter must read 000.0 ±0.1 mA. If not, adjust R7.
11. Set the Current Source for 100 mA.
12. The digital meter must read 100 ±1 mA. If not, adjust R6.
13. Set the Digital Meter Rotary Selector switch in the Actuator 1 position. Set Switch 10 Off and Switch 9 On.
14. The digital meter must read 100 ±1 mA. If not, adjust R3.
15. Repeat steps 7-14 until no adjustments are required.
16. Place the Degrees of Rotation switch in the Actuator 1 position.
17. Set the Current Source for 34 mA.
18. The Degrees of Rotation meter must read 6.1±0.1 for Actuator 1 and Actuator 2. If not, adjust R5 on the Actuator board.
19. Set the Current Source for 0 mA.
20. The Degrees of Rotation switch must read 2.0 ±0.1 for Actuator 1 and Actuator 2. If not, adjust R2 on the Phase Control board.
21. Set the Current Source for 160 mA.
22. The Degrees of Rotation meter must read 43.0 ±0.1 for Actuator 1 and Actuator 2. If not, adjust R1 on the Phase Control board.

IMPORTANT **If there is not enough adjustment for 43.0, then check to see that R38 on the Phase Control Actuator Degrees Board is 68.1 K.**

23. Check that there is no change in Actuator Degrees from 0 mA to 20 mA.

24. Repeat steps 17 through 22 until no adjustments are required.

25. Place Actuator 1 and Actuator 2 in Reverse.

26. At 20.0 mA, Actuator 1 and Actuator 2 Phase Degrees should read 43 ±0.1°. If not, adjust R4 for Actuator 1 and/or adjust R8 for Actuator 2.

27. Adjust the Actuator current to 160 mA. The Phase Degrees for Actuator 1 and Actuator 2 should read 2.0 ±0.1. If not, readjust R4 for Actuator 1 or R8 for Actuator 2.

28. Repeat steps 24 through 27 until no further adjustments are required.

29. Place both of the Actuators in Open Loop and Normal. Adjust the actuator current potentiometer from 0 to 160 mA. The Phase Degrees should increase from 2.0• and should not pass through zero. Repeat this test for both Actuators.

30. Set both Actuators in the Closed Loop mode. Place Actuator 1 and Actuator 2 Analog meters in the 400 mA position. Input 199.99 mA and adjust the meters to read 200 ±10 mA. (Adjustments are on the back of the meters). Increase the input to 400 mA, the meters should read 400 ±20 mA. (For 400 mA, use power supply and current meter.)

31. Check the Digital DVM reading on Both Actuators at 199.99 mA. The Digital DVM should read 200 ±5 mA, if not adjust R67 for Actuator 1 and R69 for Actuator 2.

IMPORTANT **The Digital DVM may read only 360 mA @ 400 mA due to saturation.**

IMPORTANT **TEST STAND 111 HAS R67 AND R69 REVERSED.**

32. Repeat steps 29 through 31 until no adjustments are required.

Three-Phase CT

1. Put the Three Phase board on an extender card.

2. Set the Alternator frequency and the Three Phase frequency switch to Line, turn the Alternator amplitude to minimum.

3. Set the Load switch for 0.5 Ω. Set the Open/Closed switch to Open Loop. Set the Frequency switch to Line.

4. Adjust the CT Level fully clockwise or to 10.0.

5. Connect a scope and an ac voltmeter from ground to A Phase CT, (pin 3 to pin 56 on the Three Phase board).

6. Adjust R4 until the ac meter reads 10.0 ±0.1 V. Make sure that it is a non distorted sine wave.

7. Move the scope and ac voltmeter to ground and B Phase CT, (pin 3 and pin 60 on the Three Phase board).

8. Adjust R5 until the ac meter reads 10.0 ±0.1 V. Make sure that it is a non distorted sine wave.

9. Move the scope and ac voltmeter to ground and C Phase CT ,(pin 3 and pin 64 on 3 phase board).

10. Adjust R6 until the Ac meter reads 10.0 ±0.1 V. Make sure that it is a non distorted sine wave.

11. Adjust the following potentiometers on the Three Phase Amp board:

IMPORTANT **The potentiometers are located on the 3-phase amplifier board. Use pin 3 for the circuit common.**

- Adjust R1 for zero ±5 mV dc at TP1.
- Adjust R3 for zero ±5 mV dc at TP2.
- Adjust R5 for zero ±5 mV dc at TP3.

12. Connect a 0.5 Ω, 5 W resistor in series with a RMS current meter to the A Phase CT Terminals on the back of the test stand.

13. Place the Test Stands Digital DVM to read the A phase CT. With the CT Level fully clockwise the A Phase current should be greater than 6.0 A.

14. Adjust the CT Level until the current meter reads 5.0 A.

IMPORTANT **Allow 45 seconds before taking any CT readings on the Test Stand Digital DVM.**

15. The Digital DVM must read the same as the ac RMS current meter ± 0.5%. If not adjust R4 on the DVM BOARD.

16. Connect an ac current meter and a scope to the B Phase CT Terminals on the back of the Test Stand. Adjust R2 on the 3 phase amp board for 5.0 ±0.1 A. Check for non distorted sine wave.

17. Select the B Phase CT on the Test Stand Digital DVM. It should read the same as the ac current meter ± 0.5%.

18. Connect an ac current meter and a scope to the C Phase CT terminals on the back of the Test Stand. Adjust R4 on the 3 phase amp board for 5.0 ±0.1 A. Check for a non distorted sine wave.

19. Select the C Phase CT on the Test Stand Digital DVM. It should read the same as current meter ±0.5%.

Three-Phase PT

1. Select the 440 position on the PT Voltage selector switch. Adjust the PT Amplitude potentiometer fully clockwise or to 10.0.

2. Connect a scope and an ac voltmeter to ground and the A Phase PT on the 3 phase board, (pin 3 and pin 57).

3. Adjust R1 on the 3 phase board for 10.0 ±0.1 Vrms. Make sure it is a non distorted sine wave.

4. Connect the scope and the ac voltmeter to ground and the B Phase PT on the 3 phase board, (pin 3 and pin 61).

5. Adjust R2 on the 3 phase board for 10.0 ±0.1 Vrms, make sure it is a non distorted sine wave.

6. Connect the scope and the ac voltmeter to ground and the C Phase PT on the 3 phase board, (pin 3 and pin 65).

7. Adjust R3 on the 3 phase board for 10.0 ±0.1 Vrms, make sure it is a non distorted sine wave.

8. Place the L-L/L-N switch in the L-N position.

9. Connect an ac voltmeter between terminals 4 and 5 on the terminal block on the front of the test stand.

10. Place switch 1 in the UP position.

11. With the PT Amplitude potentiometer fully clockwise, the amplitude should be greater than 260 V with the 3 PHASE power on.

12. Check if all 3 phases have 260 V or greater by using rotary switch #2. Positions 1, 2 and 3 correspond to A, B and C Phases respectively.

13. Place rotary switch #2 in position 1. Adjust the PT amplitude for 180 V. Set the Test Stand Digital DVM to read A Phase PT. Adjust R3 on the DVM board until the Digital DVM matches the ac voltmeter reading ±1 V.

14. Place rotary switch #2 in position 2. Adjust R6 on the 3 phase amp board for 180 V. Place the rotary switch for the Digital DVM to the B Phase PT. It should read 180 ±1 V.

15. Place rotary switch #2 to position 3. Adjust R7 on the 3 phase amp board for 180 V. Place the rotary switch for the Digital DVM to the C Phase PT. It should read 180 ±1 V.

16. Connect both channels of the oscilloscope to the A Phase PT and CT output. Channel one to A Phase PT (pin 57) and channel two to the A Phase CT (pin 56)

17. Enable the A Phase CT and adjust the amplitude of the CT's and PT's to a value suitable for seeing a complete waveform on the scope.

18. Turn the "Phase Adjust" potentiometer for a reading of +90•. The CT waveform should "Lead" the PT waveform by 90°.

19. Turn the "Phase Adjust" potentiometer for a reading of -90•. The CT waveform should "Lag" the PT waveform by 90°.

Magnetic Pickup Meter Calibration

1. Connect a Frequency Counter and a ac RMS Voltmeter between terminal 3 and terminal 15 of the terminal block on the front of the test stand.
2. Place switch 1 in the DOWN position.
3. Place the Signal Generator switch in the UP position.
4. Place the N2/ALT counter select switch in the N2 position.
5. Place the Divider N1/N3 switch to N3.
6. Set the N1, N2, N3 Speed channels to 10 kHz ±200 Hz with their Level adjust potentiometers. (Use the X1 range if possible. It may be necessary to hand select C5, 11, 17).
7. Place rotary switch 1 in position 1. The external frequency counter should read within ±1 count of the N1 Speed reading.
8. Place rotary switch 1 in position 2. The external frequency counter should read within ±1 count of the N2 Speed reading.
9. Place rotary switch 1 in position 3. The external frequency counter should read within ±1 count of the N3 Speed reading.
10. Adjust R2 on the DVM board to match the ac RMS voltmeter on terminal block 3 and 15. The amplitude should be at least 10 Vrms on each MPU if the amplitude potentiometer for each MPU is adjusted all the way Clockwise.
11. Turn the Signal Generator switch off and check that the N1, N2, N3 Speed readings change from 0 - 10 kHz ± 10 % with a 0 - 160 mA change on the actuator.

Alternator

IMPORTANT

Unless otherwise specified, all of the adjustments are on the ALTERNATOR Board. Place the Alternator Board on an Extender card. TB refers to the terminal block on the front panel of the Test Stand next to the patch.

1. Set Switch 1 to Off. Set the Signal Generator switch to On. Set the counter switch (N2/EXT INPUT/ALT) to ALT. Set the N3 Range switch to X.1.
2. Connect an RMS voltmeter to TB-6 and TB-15 on the front panel. Connect an external frequency counter to TB 3 and TB 15.
3. Set the Breaker to Off Line. Set the Phase Degree switch to PT-CT. Set the Alternator Amplitude potentiometer to full clockwise.
4. Adjust R1 on the Alternator Board for 10 ±0.1 Vac RMS at TB 6.

5. Set the Divider switch to N3. Set the divider thumbwheel to 001. Alternator Freq. switch to Div. Set the 3 PHASE FREQ. switch to LINE.

6. Connect both channels of the oscilloscope to the front panel TB-6 and TB-3 with TB-15 as ground.

7. Open S1 (located on "ALTERNATOR" board). Set rotary switch #1 to Pos. 3.

8. Use the N3 Level potentiometer and set the N3 counter to 450 Hz on the external frequency counter. Adjust R2 for 10 ±0.1 Vdc at U23, Pin 2 (4302 on the Alternator board).

9. Connect the Frequency counter between TB-6 & TB-15. With N3 still at 450 Hz, adjust R3 on the Alternator board for 450 ±1 Hz.

10. Close S1 on the Alternator board and adjust R4 for the middle of the lock range. (If you can't bring R4 into the locked range try adjusting R2.)

11. Set the BREAKER switch to ON LINE. Set the N2 Counter switch to ALT. Set the Freq. Trim potentiometer to Mid or 5.0 on the dial. Set the PT-CT switch located by the Phase Degrees Readout to PT-ALT. Set the N1 range switch to X1. Set the N3 range switch to X1. Set the N1/N3 switch located by the Thumbwheel Divider switch to N1. Turn the On-Line Speed potentiometer from CCW to CW. The N1 frequency reading should go from 0 to 10 kHz ±200 Hz. Set the N1/N3 switch to N3. Turn the On Line Speed potentiometer from CCW to CW. The N3 frequency reading should go from 0 to 10 kHz ±200 Hz.

12. Set the Line Frequency switch to 400 Hz. Adjust R7 for a 400 ±0.1 Hz. reading on the external counter. The N2/EXT/ALT frequency indicator should read 400 Hz ±1 count.

13. Set the Line Frequency switch to 50 Hz. Adjust R5 for a 50 ±0.1 Hz reading on the external counter. The N2/EXT/ALT frequency indicator should read 50 Hz ±1 count.

14. Set the Line Frequency switch to 60 Hz. Adjust R6 for a 60 ±0.1 Hz reading on the external counter. The N2/EXT/ALT frequency indicator should read 60 Hz ±1 count.

0-1 mA/0-20 mA Meter Function Test

1. Connect a current calibrator to TS-7(+) and TS-8(-) on the front panel.

2. Set all of the 0-1 mA/0-20 mA meter switches to the 1 mA position.

3. Manually zero all of the meters using the adjustment screw on the front of each meter.

4. Input 1 mA from the current calibrator. The current meters should all read 1.00 ±0.05 mA.

5. Set all of the meter switches to the 20 mA position.

6. Input 20 mA from the current calibrator. The current meters should all read 20.0 ±0.4 mA.

7. Disconnect the current calibrator.

Isolated Voltage Source

1. Connect an external calibrated dc voltmeter to TS-9(+) and TS-10(-) on the front panel.

2. Set switches 2 and 3 on and adjust ISO 1 for 10 ±.5 Vdc. Set the POS/ NEG switch to the NEG position and check for -10 V. Set the 1/10 volt switch to 1 and check for ±1 ±0.1 V.

3. Set Switches 2 & 3 off and set switches 4 & 5 on. Repeat step 2 for ISO V2.

Closed Loop Sources

1. Connect the current calibrator to TS-11(+) and TS-12(-) on the front panel.

2. Connect a dc milliamp meter to TS-13(+) and TS-14(-) on the front panel.

3. On the closed loop board set switches 1, 3, 5, 7 to open and switches 2, 4, 6, 8 in the closed position. Set switches 17, 25, 33, 41 on front panel to the on position.

4. Adjust the range potentiometer for source 1 CW and adjust the level potentiometer for source 1 to 5.0.

5. Input 4.0 Vdc from the calibrator to the test stand.

6. You should be able to adjust the level potentiometer for 40 mA ±5.
7. Set switches 17, 25, 33, 41 on the front panel to the off position.

8. Repeat steps 3 through 7 for sources 2, 3 and 4 using the following switches on the front panel:
   For Source 2, use switches 18, 26, 34, 42.
   For Source 3, use switches 19, 27, 35, 43.
   For Source 4, use switches 20, 28, 36, 44.

10-50 Vdc/120 Vac/0-150 Vdc/0-120 Vac Power Sources

1. Connect an dc voltmeter to the terminal block on the I/O panel on the rear of stand labeled 10-50 Vdc.

2. Set the test stand power on/off switch to on.

3. Set the 10-50 Vdc on/off switch to the on position.

4. Adjust the 10-50 Vdc potentiometer from CCW to CW. Verify that the output at the terminal block goes from 10 to 50 Vdc and the analog meter on the front panel also goes from 10 to 50 Vdc.

5. Set the 10-50 Vdc on/off switch to the off position. Disconnect the dc voltmeter.

6. Connect an ac voltmeter to the terminal block on the back of the test stand labeled 120 Vac.

7. Set the front panel switch labeled 120 Vac on/off to the on position.(This is located next to the 10-50 Vdc power supply)

8. Verify that the output is 120 Vac or line power.

9. Set the 120 Vac on/off switch to off. Verify that the output goes to zero. Disconnect the ac voltmeter.

10. Connect an ac voltmeter to the terminal block on the back panel labeled 0–120 Vac.

11. Set the 0-150 Vdc/0-120 Vac on/off switch to on.(This is located on the lower front panel of the test stand next to the two solenoids.)

12. Vary the variac from CCW to CW. The output on the terminal block should go from 0 to 120 Vac or line power.

13. Connect a dc voltmeter to the terminal block labeled 0-150 Vdc on the back panel.

14. Vary the variac from CCW to CW. Verify that the output on the terminal block goes from 0 to 150 Vdc. Set the variac CCW.

15. Set the 0–150 Vdc/120 Vac on/off switch to off. Disconnect all meters. Set the test stand power on/off switch to off.

0-40 mA Current Sources and LEDs

1. Remove the test Patch and install the LED/SOURCE test patch.

2. Connect a dc mA meter to the patch. Adjust, R4 on the Voltage Current Source board for 4 ±0.1 V at TP1.

3. Put Sources 1 through 8 in the milliamp position.

4. Close switches 1 and 33 on the front panel to check source 1. Verify that Source 1 can be adjusted with it's front panel potentiometer from 0 to 40 mA ± 3 mA. Put switch 1 and 33 in the down position. Check the remaining 24 sources the same way using the switches listed below. Only have the switches up for one source at a time.

Switches	**Source**
2 and 34	2
3 and 35	3
4 and 36	4
5 and 37	5
6 and 38	6
7 and 39	7
8 and 40	8
9 and 41	9
10 and 42	10
11 and 43	11
12 and 44	12
13 and 45	13
14 and 46	14
15 and 47	15
16 and 48	16
17 and 49	17

18 and 50	18
19 and 51	19
20 and 52	20
21 and 53	21
22 and 54	22
23 and 55	23
24 and 56	24

5. Put the switches for sources 1 through 8 in the 0-10 Vdc position. Remove the dc milliamp meter from the patch and connect a dc voltmeter to the red and black connections on the patch. Close switches 1 and 33 on the front panel. Verify that source 1 through 8 can be adjusted with its front panel potentiometer from 0 to 10 ±0.5 Vdc. Put switch 1 and 33 in the down position. Check the remaining 8 sources the same way using the switches listed below. Only have the switches up for one source at a time.

Switches	**Source**
2 and 34	2
3 and 35	3
4 and 36	4
5 and 37	5
6 and 38	6
7 and 39	7
8 and 40	8

6. Remove the voltmeter from the patch and open switches 1 through 56.

7. LEDs--With the same patch in place and switch 70 in the down position check that LEDs 1 through 64 light.

Actuator Test

1. Remove the LED/SOURCE test patch from the test stand and install the T96046 ACT Function TEST Patch.

2. Connect a function generator to TS-1(+) and TS-10(-) on the front panel. Set the function generator for a 15 V peak to peak, 2500 Hz triangle waveform.

3. Connect a dc current calibrator to TS-2(+) and TS-3(-) on the front panel.

4. Set switch 5 up to select LVDT FEEDBACK. LED 1 will light.

5. Set Switches 1 and 3 up for Actuator 1. Select Actuator 1 DEGREES ROTATION, NORMAL, DUAL FUEL, CLOSED LOOP, and Actuator 1 on the test stand digital DVM.

6. Connect an oscilloscope to TS-4(+) and TS-5(-) on the front panel.

7. Set the current calibrator to 90 mA. Adjust the zero pot on the Actuator Board so that the oscilloscope displays a signal of 0 Vdc and 0 Vac. Set the calibrator to 20 mA. Increase the current calibrator output incrementally to 160 mA. The waveform on the oscilloscope will start to decrease and pass through 0 V at 90 mA ± 10 mA. Then the signal should start to increase again. At 160 mA the signal should be the same as at 20 mA ± 5%. (NOTE: The gain potentiometer on the Actuator Board can be adjusted for this.)

IMPORTANT **The signal should not decrease from 20 mA to 0 mA input from the current calibrator. There is a minimum clamp adjustment on the actuator board for this.**

8. Set Switch 5 down to select RVDT FEEDBACK and set the function generator for a square waveform output. The frequency should be 2500 Hertz and the amplitude should be 15 V peak to peak.

9. The display on the oscilloscope will be a square wave that increases when the current calibrator is changed from 20 mA to 160 mA. (The wave form should not change from 20 mA to 0 mA because of the clamp mentioned in the note above.)

10. Set switches 1 and 3 off. Set switches 2 and 4 on. Connect an oscilloscope to TS-6 (+) and TS-7 (-) on the front panel. Repeat steps 1-9 for Actuator 2. (For Actuator 2 the zero Adjustment is R145 and the gain Adjustment is R139 on the Actuator Board.)

EGT, CDP, and Extraction

1. Set the Dual Fuel/Extraction switch to Extraction.

2. Connect a dc multimeter to TS-8(+) and TS-9(-) on the front panel. Set switch 9 on the front panel to the on position.

3. Verify that adjustment of the EGT 1 Level potentiometer produces a positive and negative millivolt signal.

4. Set switch 9 off and set switch 10 on. Verify that adjustment of the EGT 2 Level potentiometer produces a positive and negative millivolt signal. Set switch 10 off and move the ground lead of the multimeter to TS-10 on the front panel.

5. Set switch 11 on. Verify that the CDP Level potentiometer can be adjusted for a 0 to 5 Vdc signal.

6. Set switch 11 off and switch 12 on. Verify that the CDP/EXT Level potentiometer can be adjusted for a 0 to 5 Vdc signal. Set the test stand Power On/ Off switch to the Off position. Disconnect all test equipment from the test stand. Remove the test patches.

Post Calibration Procedure

1. Follow the appropriate Standard procedures for your location.

Chapter 3.
Patches

Calibration Patch
Test Stand Front Panel Terminal Block

Terminal	Function
1	ACT 1 & 2 Coil Positive Switches 9 & 10
2	ACT 1 & 2 Common for both actuators
3	N1, N2, N3 Rotary Switch 1
4	A, B, C PHASE, PT Signals Rotary Switch 2
6	Alternator
7	+ Analog Meters
8	– Analog Meters
9	+ Isolated Voltages
10	– Isolated Voltages
11	+ IN Closed Loop Source
12	– IN Closed Loop Source
13	+ OUT Closed Loop Source
14	– OUT Closed Loop Source
15	Test Stand Ground

Calibration Patch
Patch Connections

Patch	Connections	Patch	Connections
1	1C-48, 4C-50	28	2A-9, 1C-29
2	1A-15, 3A-35	29	2B-47, 1C-3
3	1A-17, 3A-34	30	2B-49, 1C-7
4	1A-19, 3A-33	31	1C-4, 1C-8, 1C-37
5	3A-36, 1C-31	32	2B-48, 1C-5
6	1A-16, 1C-39	33	2B-50, 1C-9
7	1A-18, 1C-40	34	1C-6, 1C-10, 1C-38
8	1A-20, 1C-41	35	4C-46, 2A-18
9	1A-25, 3A-39	36	4C-47, 2A-27
10	1A-26, 3A-38	37	4C-48, 2A-36
11	1A-27, 3A-37	38	4C-49, 2A-45
12	3A-40, 1C-32	39	1A-33, 2A-10
13	1C-33, 1C-47	40	1A-34, 2A-19
14	1A-31, 1C-34	41	1A-35, 2A-28
15	1C-17, 1C-35	42	1A-36, 2A-37
16	1C-18, 1C-19	43	1A-37, 2A-11
17	1C-20, 1C-21	44	1A-38, 2A-20
18	1C-22, 1C-23	45	1A-39, 2A-29
19	1C-24, 1C-25	46	1A-40,2A-38
20	1C-26, 1C-27	47	1A-41, 2A-12
21	1C-28, 1C-36	48	1A-42, 2A-21
22	1C-1, 1C-42	49	1A-43, 2A-30
23	1C-2, 3A-45	50	1A-44, 2A-39
24	1A-3, 2A-1	51	1A-45, 2A-13
25	1A-4, 1C-30	52	1A-46, 2A-22
26	1A-10, 2A-2	53	1A-47, 2A-31
27	1A-11, 1C-30	54	1A-48, 2A-40

Actuator Function Test Patch
Patch Connections

Ground to TS-10	1C-48 to 1C-38
EGT COM to TS-9	1C-49 to 1C-37
EGT-1 to Switch-9	1A-21 to 2A-1
EGT-2 to Switch-10	1A-22 to 2A-2
CDP to Switch-11	1A-23 to 2A-3
CDP/EXT to Switch-12	1A-24 to 2A-4
SWITCH COMMON 9-16 to TS-8	2A-9 to 1C-36
ACT 1 EXCITATION to Switch-1	1A-2 to 1C-1
ACT 2 EXCITATION to Switch-2	1A-9 to 1C-3
Switch-1 to Switch-2 to TS-1	1C-2 to 1C-4 to 1C-29
ACT 1 and ACT 2 EXCITATION (-) to COMMON	1A-1 to 1A-8 to 1C-39
ACT 1 to Switch-3	1A-3 to 1C-5
ACT 2 to Switch-4	1A-10 to 1C-7
Switch-3 to Switch-4 to TS-2	1C6 to 1C8 to 1C30
ACT 1 to ACT 2 to TS-3	1A4 to 1A11 to 1C31
RVDT/LVDT SELECT to Switch-5 to LED-1	1C-50 to 1C-9 to 2C-1
Switch-5 to Ground	1C-10 to 1C-40
ACT 1 + FEEDBACK to TS-4	1A-5 to 1C-32
ACT 1 - FEEDBACK to TS-5	1A7 to 1C33
ACT + FEEDBACK to TS-6	1A-12 to 1C-34
ACT 2 - FEEDBACK to TS-7	1A14 to 1C35

LED/Source Patch
Patch Connections

Chain Together
1C-2
1C-4
1C-6
1C-8
1C-10
1C-12
1C-14
1C-16
2A-9
2A-18
2A-27 (+ Terminal on patch)
2B-4 (- Terminal on patch)
2A-36
2A-45
2C-1 through 2C-50 and 3A-1 through 3A-14 Connect this chain to 2B-40 Then connect 2B-39, 1C-45

Led/Source Patch (Cont)

Separate Connections	
1B-1, 1C-1	1B-25, 2A-5
1B-2, 2A-28	1B-26, 2A-41
1B-3, 1C-3	1B-27, 2A-6
1B-4, 2A-29	1B-28, 2A-42
1B-5, 1C-5	1B-29, 2A-7
1B-6, 2A-30	1B-30, 2A-43
1B-7, 1C-7	1B-31, 2A-8
1B-8, 2A-31	1B-32, 2A-44
1B-9, 1C-9	1B-33, 2A-10
1B-10, 2A-32	1B-34, 2A-46
1B-11, 1C-11	1B-35, 2A-11
1B-12, 2A-33	1B-36, 2A-47
1B-13, 1C-13	1B-37, 2A-12
1B-14, 2A-34	1B-38, 2A-48
1B-15, 1C-15	1B-39, 2A-13
1B-16, 2A-35	1B-40, 2A-49
1B-17, 2A-1	1B-41, 2A-14
1B-18, 2A-37	1B-42, 2A-50
1B-19, 2A-2	1B-43, 2A-15
1B-20, 2A-38	1B-44, 2B-1
1B-21, 2A-3	1B-45, 2A-16
1B-22, 2A-39	1B-46, 2B-2
1B-23, 2A-4	1B-47, 2A-17
1B-24, 2A-40	1B-48, 2B-3

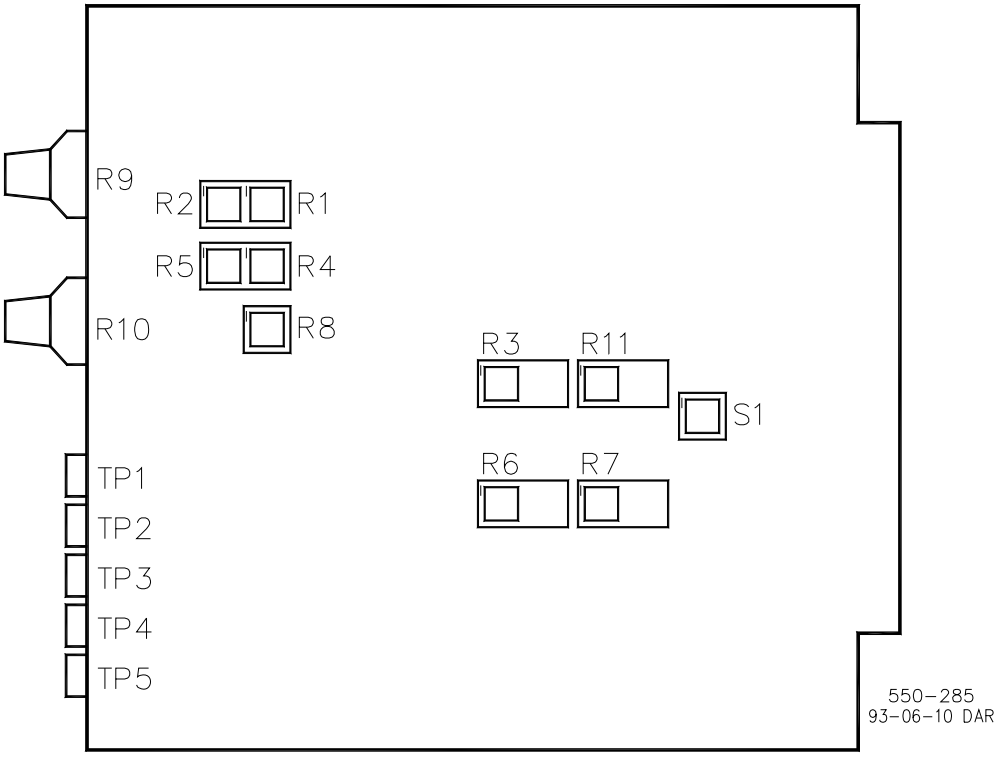

Figure 3-1. Actuator, EGT, CDP

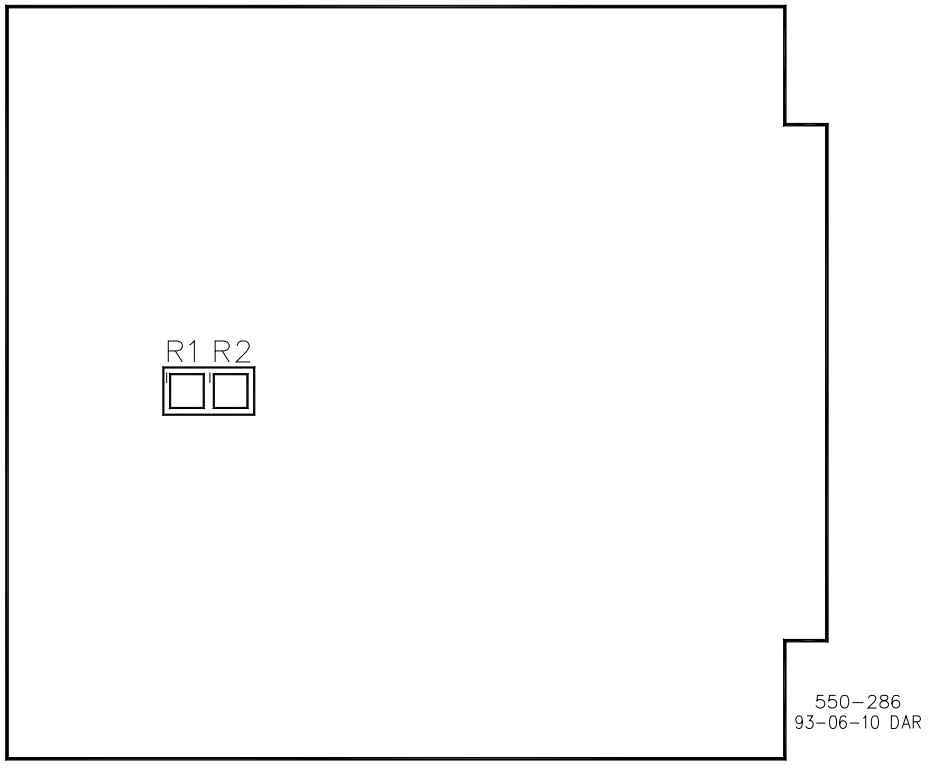

Figure 3-2. Phase Control Actuator Degrees

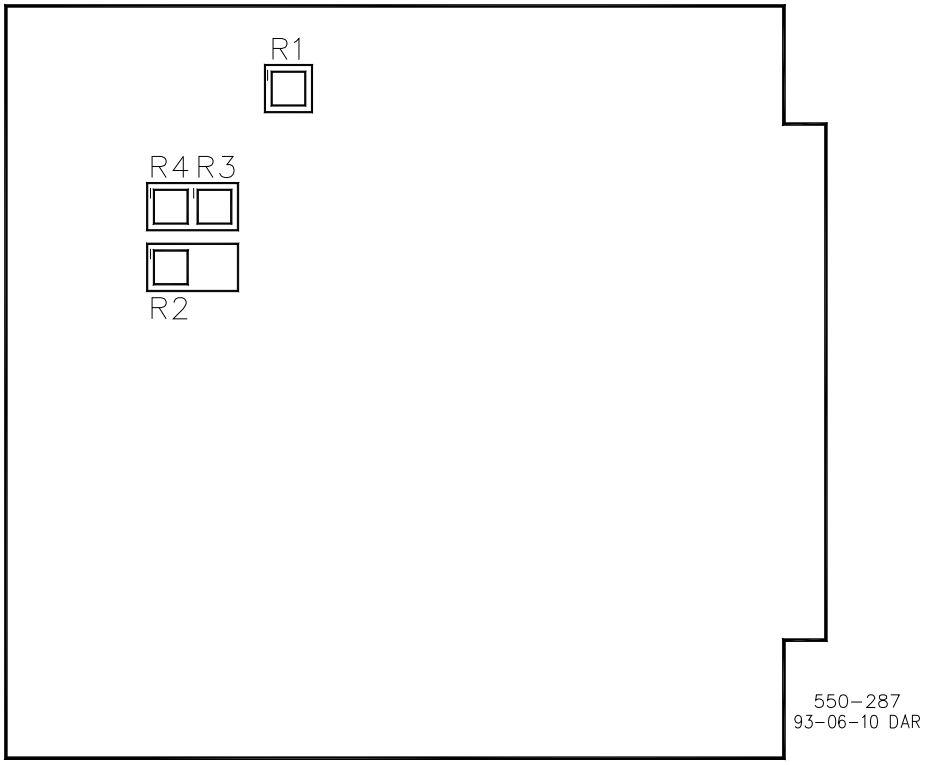

Figure 3-3. DVM

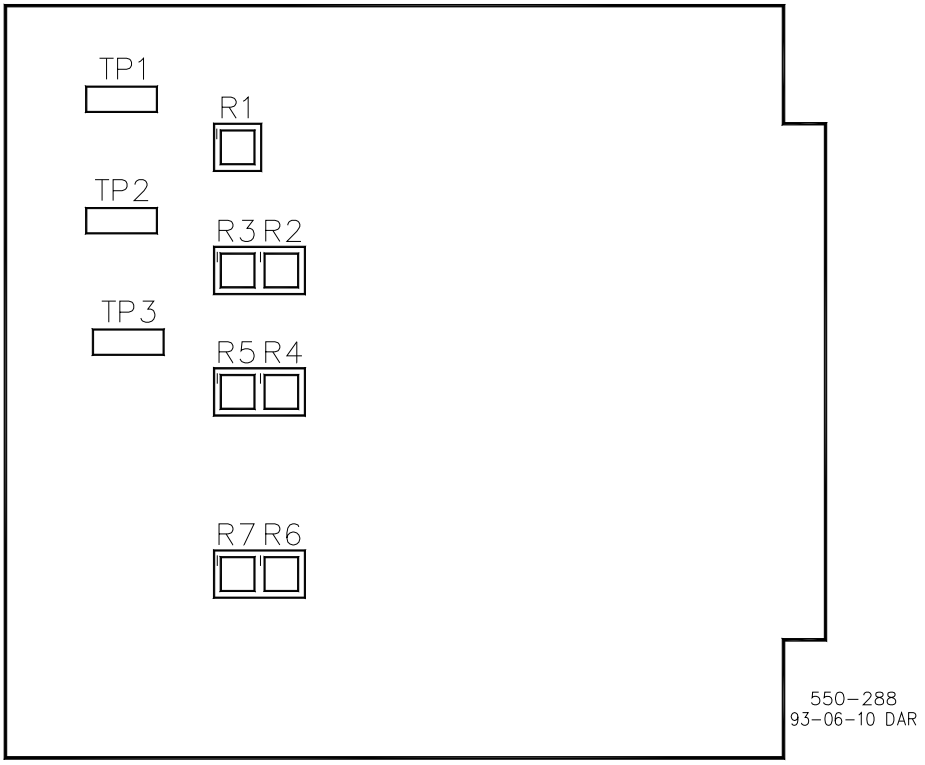

Figure 3-4. Three-Phase Amplifier

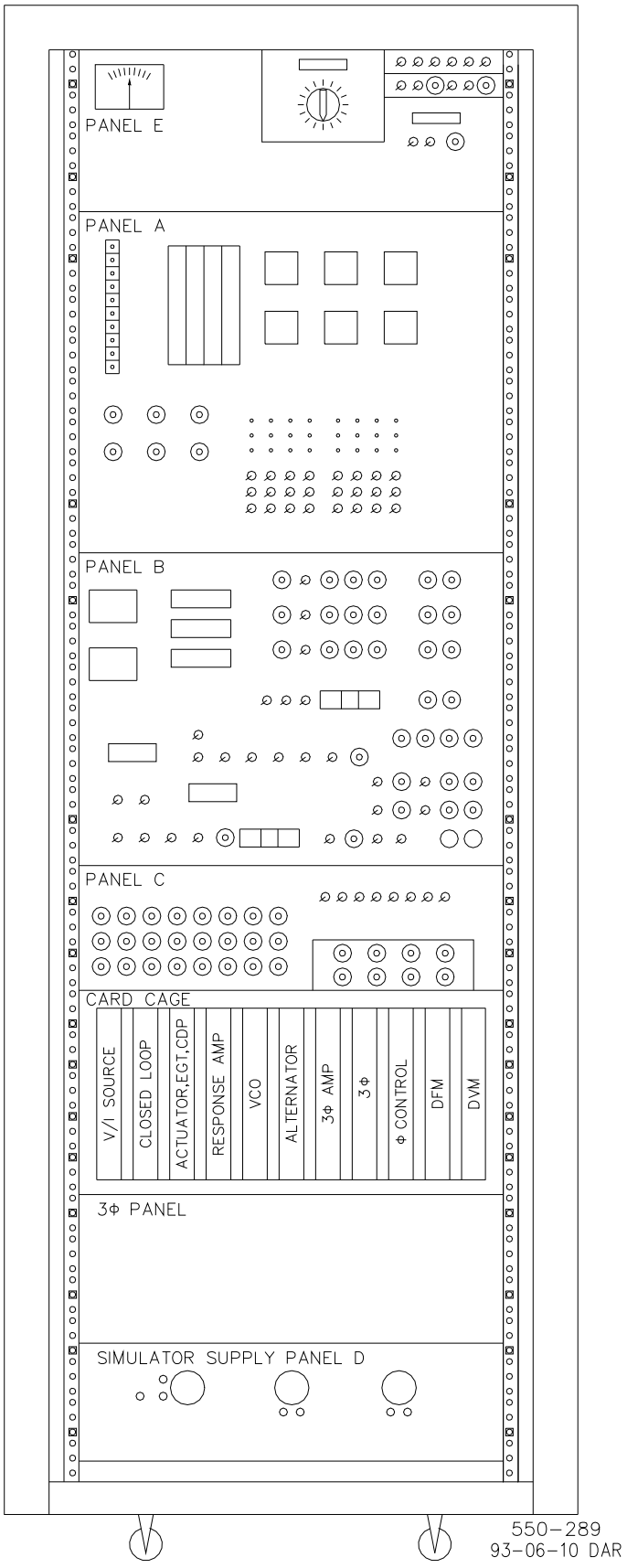

Figure 3-5. Test Stand Front View

Chapter 4.
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 is in need of 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 published at **www.woodward.com/directory**.

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 (129) 4097100
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 (129) 4097100
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 (129) 4097100
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

For the most current product support and contact information, please visit our website directory at **www.woodward.com/directory**.

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.

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 25094.

PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

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.

2012/9/Colorado