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NUCLEAR INSTRUMENT MODULE MAINTENANCE MANUAL

Part 7

SERVO DEMAND DRIVE UNIT, ORNL MODEL Q-2607

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ABSTRACT

The circuit, applications, maintenance procedures, and acceptance tests for a Servo Demand Drive Unit are described. The unit consists of a motor-driven, precision potentiometer assembly and adjustable rotary limit switches. Accurate external reference voltages are applied across the potentiometer sections, and the demand signals are taken from the wipers of the potentiometers. The drive motor is actuated through remote switching from a source of 32 v dc.

CONTENTS

1. DESCRIPTION

1.1 General

The Servo Demand Drive Unit consists of a motor-driven, dual precision potentiometer and adjustable rotary limit switches. Accurate external dc reference voltages are applied across the potentiometer sections, and the demand signals are taken from the wipers of the potentiometers. A front-panel meter displays the demand signal calibrated 0 to 110%, corresponding to 0 to 8.25 v. The drive motor is actuated remotely through suitable switching from a source of 32 v dc.

1.2 Construction

The Servo Demand Drive Unit is constructed in a module 2.83 in. wide, 4.72 in. high, and 11.90 in. deep. It is a standard "2-unit" plug-in module of the Modular Reactor Instrumentation series depicted on drawings Q-2600-1 through Q-2600-5.

1.3 Application

This module provides a remotely adjusted reference voltage which is used as the power demand signal in a reactor power-level controller. The voltage vs percent power calibration and the rate of change of demand signal are both fixed. The upper and lower limits of power demand are adjustable mechanically.

1.4 Specifications

1. Calibration: 0 to 8.25 v dc equals 0 to 110% power demand (7.50 v = 100%) and has provisions for an external meter, 0 to 500 μa, and 990 ohms. Both positive and negative voltages are available simultaneously.

2. Demand rate: the rate of change of demand is 1.5%/sec or 90%/min within ±10%.

3. Limits: the upper and lower limits of power demand are adjustable from 5% to greater than 110%. The initial adjustment limits are: lower, 10%; upper, 110%.

4. Power required: +32 ± 4 v dc, 1 amp, unregulated; +10.00 ± 0.05 v dc, 25 ma, regulated within ±0.05%; -10.00 ± 0.05 v dc, 25 ma, regulated within ±0.05%.

1.5 Applicable Drawings and Specifications

The following list gives the drawing numbers (ORNL Instrumentation and Controls Division drawings numbers) and subtitles and the fabrication specification number for the Servo Demand Drive Unit:

1. Q-2607-1 Circuit.
2. Q-2607-2 Details.
3. Q-2607-3 Metalphoto Panel.
4. Q-2607-4 Assembly.
5. Q-2607-5 Parts List.
6. Q-2607-6 Meter Scale.
7. SF-241 Fabrication Specification.

The following list gives the drawing numbers and subtitles for the Plug-In Chassis System:

1. Q-2600-1 Assembly.
2. Q-2600-2 Details.
3. Q-2600-3 Details.
4. Q-2600-4 Details.
5. Q-2600-5 Details.
6. Q-2600-6 Details.

2. THEORY OF OPERATION

The Servo Demand Drive Unit is basically two, ganged, motor-driven, precision potentiometers and a rotary limit switch assembly. A +10 v reference is applied across one potentiometer, and a -10 v reference across the other. The demand signal output voltages are taken from the potentiometer wipers, and both positive and negative demand signals are available simultaneously. A front-panel meter calibrated in "Percent Power Demand" is driven from the wiper of potentiometer R3A. A remote 500-μa meter, located on the operating console, is also driven from the same point through appropriate multiplier resistors. The percent power calibration is that 0 to 8.25 v equals 0 to 110% power demand, or that 7.50 v equals 100%.

The drive motor is a standard Globe Industries, type SS-2, 27 v dc motor with an integral gear train. The output shaft speed is nominally 6.2 rpm with 32 v dc applied through a 30-ohm, 3-w dropping resistor. This yields a demand speed of about 90% power demand per minute. Switching is done remotely -- usually from the operating console.

The dual potentiometer drive motor and rotary limit switch are coupled as a unit with spur gears. The motor is equipped with a slip clutch to prevent damage to the precision potentiometers if the limit switches fail to operate or are misadjusted.

The rotary limit-switch assembly also has mechanical stops. To allow greater flexibility, the limit-switch contacts are brought out on connector pins instead of being connected internally. Both raise and lower demand limits are adjustable mechanically on the rotary limit-switch assembly. Initial adjustment (see Calibration Procedures, Sect. 4.3) sets the range from 10 to 110% power demand.

3. OPERATING INSTRUCTIONS

3.1 Installation

The Servo Demand Drive Unit is a module in the ORNL Modular Reactor Instrumentation series. Like the other modules of the series, it has standard connectors and dimensions and a pin- and hole-code on the rear plate so that the module will not be inserted in a wrong location in a drawer. The module is installed by placing it in its proper location, inserting the module firmly, and tightening the thumb screw. The module may be plugged in with power on without damage to the module. Some special precautions may be necessary if the module is being replaced into an operating system.

3.2 Operating Controls

All operating controls are external to the module and will be described in appropriate systems procedures.

3.3 Connections

All connections to the module are made through the rear connector P14 when the module is inserted.

4. MAINTENANCE INSTRUCTIONS

4.1 General

This module is designed to operate continuously with a minimum of maintenance and adjustment. No periodic adjustments are required.

4.2 Periodic Maintenance

Periodic maintenance is not required.

4.3 Calibration

Calibration instructions are combined with the Acceptance Test Procedure, Sect. 6.

5. REPLACEABLE PARTS LIST

A description and an ORNL Stores Number for all replaceable parts are given in Table 1.

Table 1. Replaceable Parts List

Part No.	ORNL Stores No.	Description
--	--	Direct current motor, type SS, with planetary gear reducer, Globe Industries, Inc., part no. 43A151-2, 27 v, integral gear reducer, 1853 to 1 reducer, ball bearing output shaft, output shaft 6.2 rpm, 1-3/8 in. diam by 3-1/8 in. long.
		Miniature adjustable limit switch and stop, 0-25 revolutions, Precision Mechanisms Corp., model LS-302.
R3A, R3B		Potentiometer, 10 turn, ±3% resistance tolerance, ±0.25% linearity tolerance, two-section, ganged, servo mount with ball bearings, front section 500 ohms, back section 500 ohms, Helipot model 7223, consisting of R5KL.25 and R5KL.25.

Table 1. Replaceable Parts List (cont'd)

Part No.	ORNL Stores No.	Description
		Miniature slip clutch assembly, PIC Design Corp., catalog No. R3-11.
M1	06-050-1835	Meter, 0-50 μa dc, 1175 ohm coil, accuracy ±2% full scale, Weston No. 206-5601101. Mark as shown on drawing Q-2607-6
R5	06-933-6200	Resistor, 30 ohms, ±5%, 3 w, ww, axial leads, Ohmite code 7/16-A-54-F.
R4	06-932-0165	Resistor, 30 kilohms, ±1%, 1/2 w, Stemag, type SLAK.
R2	06-932-0199	Resistor, 200 kilohms, ±1%, 1/2 w, Stemag, type SLAK.
R2A	06-932-0251	Resistor, 1 megohm, ±1%, 1/2 w, Stemag, type SLAK.
D1, D2	06-995-7152	Rectifier, 400 v piv, 1a, type 1N4004 Motorola.

6. ACCEPTANCE TEST PROCEDURES

6.1 Test Equipment

The following test equipment is required:

1. Power supply, 32 v dc, 0.5 amp, unregulated.

2. Power supply, -10.00 ± 0.05 v dc, 0.1 amp regulated.

3. Precision voltmeter, 0.1% or better, range 0 to 10 v, 50 kilohms/v or higher.

6.2 Adjustment and Test Procedures

1. To connect the motor for operation, jumper pin Y and pin J together. Connect pin B and pin V to the 32-v supply through a reversing switch or clip leads that can be easily reversed. Do not apply power.

2. Make a preliminary adjustment of the limit switches so that the "lower limit" is actuated when the Helipot is approximately 3/4 turn from the counterclockwise limit of the Helipot (viewed from the shaft end, front of module) and the "raise limit" is actuated when the Helipot is approximately 8-1/4 turns from the counterclockwise limit. This is easily accomplished by: (1) adjusting the limit switch unit (refer to the adjustment procedure in Limit Stop Assembly, Sect. 6.3) to have a span between limits of about 7-1/2 turns with the gears unmeshed; and (2) remeshing the gears with the limit switch unit at its clockwise limit and the Helipot at 3/4 turn from its counterclockwise limit.

3. Adjust the slip clutch for minimum tension (easiest slip) and tighten the lock nut. This will be its permanent setting.

4. Momentarily apply +32 v to pin B, and check that the motor turns counterclockwise. If it does not turn counterclockwise, interchange the leads to pins B and J within the module.

5. Apply +32 v (or less for slower speed) to pin B until the "raise limit" is reached (Helipot clockwise) and the motor stops. If the motor does not stop, either the wiring to the two limit switches is interchanged or diodes D1 and D2 are reversed, or both.

6. Apply negative voltage to pin B and similarly check the "lower limit."

7. With exactly 32 v applied, check the motor speed in both directions. It should be 6.2 ± 0.3 rpm.

8. Jumper pin P and pin R together. Jumper pin X and pin U together. Connect -10 v dc from pin X to pin W. The panel meter should now read up scale.

9. Connect a precision voltmeter from pin C to ground and proceed to adjust the limits as in step 2 very carefully to obtain the following meter readings at the limits: (a) "Raise limit," 8.25 ± 0.1 v; and (b) "Lower limit," 0.75 ± 0.1 v. These readings should be obtained when the motor is driven into the limits with a full 32 v applied.

10. Check that the panel meter reads 10% at the "Lower limit" and 110% (full scale) at the "Raise limit." The meter accuracy should be within 3%. If necessary, trim the meter multiplier resistor R2 by shunting with another resistor until the panel meter indicates correctly.

6.3 Limit Stop Assembly

6.3.1 Adjustment Procedure for Precise Angle Between Limit Stops

1. Clockwise and counterclockwise directions referred to herein are viewed from the end cap as in Fig. 1, A-A.

2. Range adjustment effects the clockwise shaft limit only.

3. a. Loosen the locknut at the end of the unit just enough to allow rotation of the adjusting screw.

b. Rotate the adjusting screw clockwise as far as it will go using a 1/16 in. hex wrench. The unit is now set for zero shaft rotation.

c. Turn the adjusting screw counterclockwise through an angle equal to the required range, i.e., one revolution for 360°, two revolutions for 720°, etc.

d. Tighten the locknut in place.

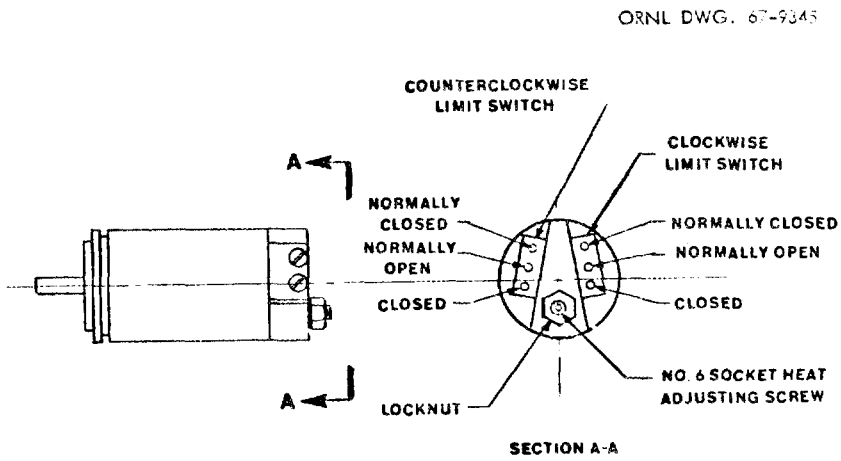

Fig. 1. Limit Stop Assembly.

6.3.2 Adjustment Procedure for Precise Angle Between Switching

1. Use the same procedure described in 6.3.1 except that the counterclockwise angle to be set in by the hex wrench (as in paragraph 3.c) must be the required switching angle plus the overtravel built into the unit. This is approximated by setting the switching angle plus 45°.

2. When it is necessary to trim to a fine adjustment when the limit switch is clamped in place on the gear box, it should be remembered that range is increased by counterclockwise rotation and decreased by clockwise rotation.

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