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NUCLEAR INSTRUMENT MODULE MAINTENANCE MANUAL

Part 28

TEMPERATURE SERVO DEMAND DRIVE UNIT, ORNL MODEL Q-2628

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ABSTRACT

The Temperature Servo Demand Drive Unit provides a means of changing the setpoint, at a fixed rate, of a nuclear reactor rod controller or servo. The module basically consists of a motor-driven potentiometer with adjustable limit switches. The module is intended for use in the Molten-Salt Reactor Experiment temperature servo, and is packaged in a standard "2-unit" plug-in module of the ORNL Modular Reactor Instrumentation series.

The circuit, application, maintenance procedures, and acceptance tests for the unit are described.

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1. DESCRIPTION

1.1 General

The Temperature Servo Demand Drive Unit provides a means of changing the setpoint, at a fixed rate, of a nuclear reactor rod controller or servo. The module basically consists of a motor-driven potentiometer with adjustable upper and lower limit switches.

1.2 Construction

The unit is contained in a single 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 ORNL drawings Q-2600-1 through Q-2600-5.

The output is displayed on a front-panel meter.

1.3 Application

Since the unit is intended for use in the Molten-Salt Reactor Experiment temperature servo, the panel meter is calibrated in °F from 1100 to 1300°F. However, this module may be used for other applications by changing the meter scale calibration. If the output voltage level requires changing (typically 0 to 10 v), it will be necessary to change both the internal and external meter resistors.

1.4 Specifications

1.	Output voltage range:	0 to +6.66 v.
2.	Output current:	1/3 ma into 50 kilohm load.
3.	Scale:	1100 to 1300°F
4.	Rate of change of output:	adjustable from 0 to 3-1/3 v/min, or 0 to 100°F/min.

1.5 Applicable Drawings

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

1.	Q-2628-1	Circuit.
2.	Q-2628-2	Details.

3.	Q-2628-3	Metalphoto Panel.
4.	Q-2628-5	Assembly.
5.	Q-2628-6	Parts List.

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.

2. THEORY OF OPERATION

2.1 General

The Temperature Servo Demand Drive Unit consists of a motor-driven potentiometer with variable speed adjustment. The span of the potentiometer is fixed by adjustable upper and lower limit switches.

2.2 Circuit Description

The unit has a 3-1/3 rpm, 27-v dc motor which is geared (1:1) to a rotary limit-switch assembly (Fig. 1). The switch assembly is also geared (1:1) to a 10-turn potentiometer. The potentiometer output is coupled directly to a 50-μa panel meter whose range is fixed by resistors R3 and R5. In addition, the output of the potentiometer is connected from pin T of the module to the servo. An external meter can be supplied from pin M; the meter range and sensitivity are fixed by resistors R1 and R2. Also contained in the module is a 30-rpm, 115-v ac motor with an adjustabel cam mounted on its output shaft which operates a microswitch.

Figure 2 shows a typical installation of a Temperature Servo Demand Drive Unit. Any time contact K1 is closed, the dc motor may be driven at its design speed (3-1/3 rpm). Since the potentiometer is 1:1 geared to the motor, this corresponds to a 3-1/3 v/min rate of change of the output, or 100°F/min. If slower rate of change is required, K1 contact is opened and the dc motor is excited only when the cam-driven microswitch is closed. Therefore, the rate of change of demand may be set to very low values by proper adjustment of the cam.

For the MSRE the maximum rate of change of demand (when K1 is closed) is 100°F/min; when driven through the microswitch, the rate is 5°F/min.

3. OPERATING INSTRUCTIONS

3.1 Installation

The Temperature Servo Demand Drive Unit is a module in the ORNL Modular Reactor Instrumentation series. Like the other modules in this series, it has standard connectors and dimensions and has 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.

3.2 Operating Controls

The panel meter is calibrated to indicate temperature demand from 1100 to 1300°F. This corresponds to a voltage output of 0 to +6.66 v.

3.3 Connections

All connections are made through the rear connector P23 when the module is inserted.

4. MAINTENANCE INSTRUCTIONS

4.1 General

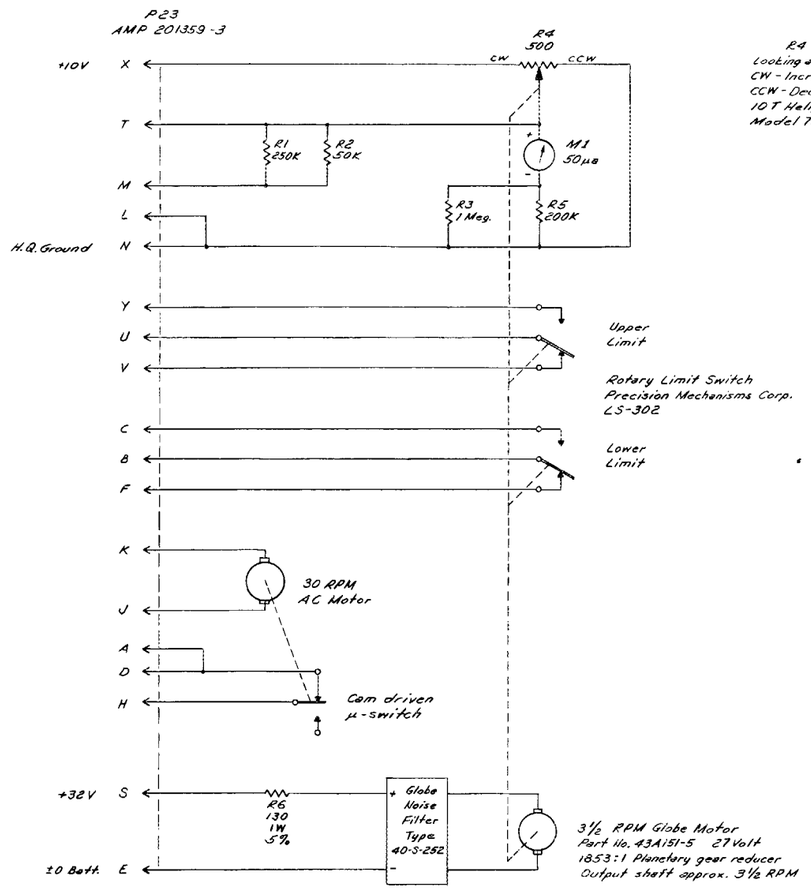
This module is designed to operate continuously with a minimum of maintenance and adjustment. Should a failure occur, any part listed in the Replaceable Parts List, Sect. 5, may be replaced.

4.2 Calibration Procedures

There are no calibration procedures unless it is desired to change the rate of change of demand, when the adjustment procedure given in Sect. 6.2 should be followed.

5. REPLACEABLE PARTS LIST

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



R4
Looking at shaft end
CW - Increase
CCW - Decrease
10 T Helipot
Model 7223

NOTES

1. All resistors are ½W, 1% deposited carbon except as noted.

NO.	REVISIONS	DATE	APPD	APPD
1	Motor Speed was 60 RPM, Added Ref.	9-8-65	[illegible]	

DRAWN	DATE	SUBMITTED	DATE	APPROVED	DATE
C.E. Monsoonier	11-4-63	[illegible]	7-21-64	[illegible]	7-22-64
DESIGNED	DATE	APPROVED	DATE	APPROVED	DATE
CHECKED	DATE	APPROVED	DATE	APPROVED	DATE

9-17-65	R1	Q-2628-1 R1	DTI
9-17-65	R1	RC13-13-7A R1	ENF
8-20-64	R0	Q-2628-1	DTI
7-22-64	R0	RC13-13-9A	ERF
DATE	CHKD	SEPIA ISSUED	APPD BY

SEPIAS ISSUED FROM Q-2628-1

Meter Face	Q-2628-7
Parts List	Q-2628-6
Assembly	Q-2628-5
Metalphoto Panel	Q-2628-3
Details	Q-2628-2
REFERENCE DRAWINGS	DWG. NO.

DESIGN RESPONSIBILITY E.N. FRAY

MODULAR REACTOR INSTRUMENTATION

TEMPERATURE SERVO DEMAND DRIVE UNIT CIRCUIT

INSTRUMENTATION AND CONTROLS DIVISION
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY

DRAWN	DATE	ADOPTED	DATE	APPROVED	DATE
E.N. Fray	9-17-65	[illegible]	1-17-65		

Q-2628-1 R1

Fig. 1. Circuit of Temperature Servo Demand Drive Unit.

ORNL DWG. 68-1291

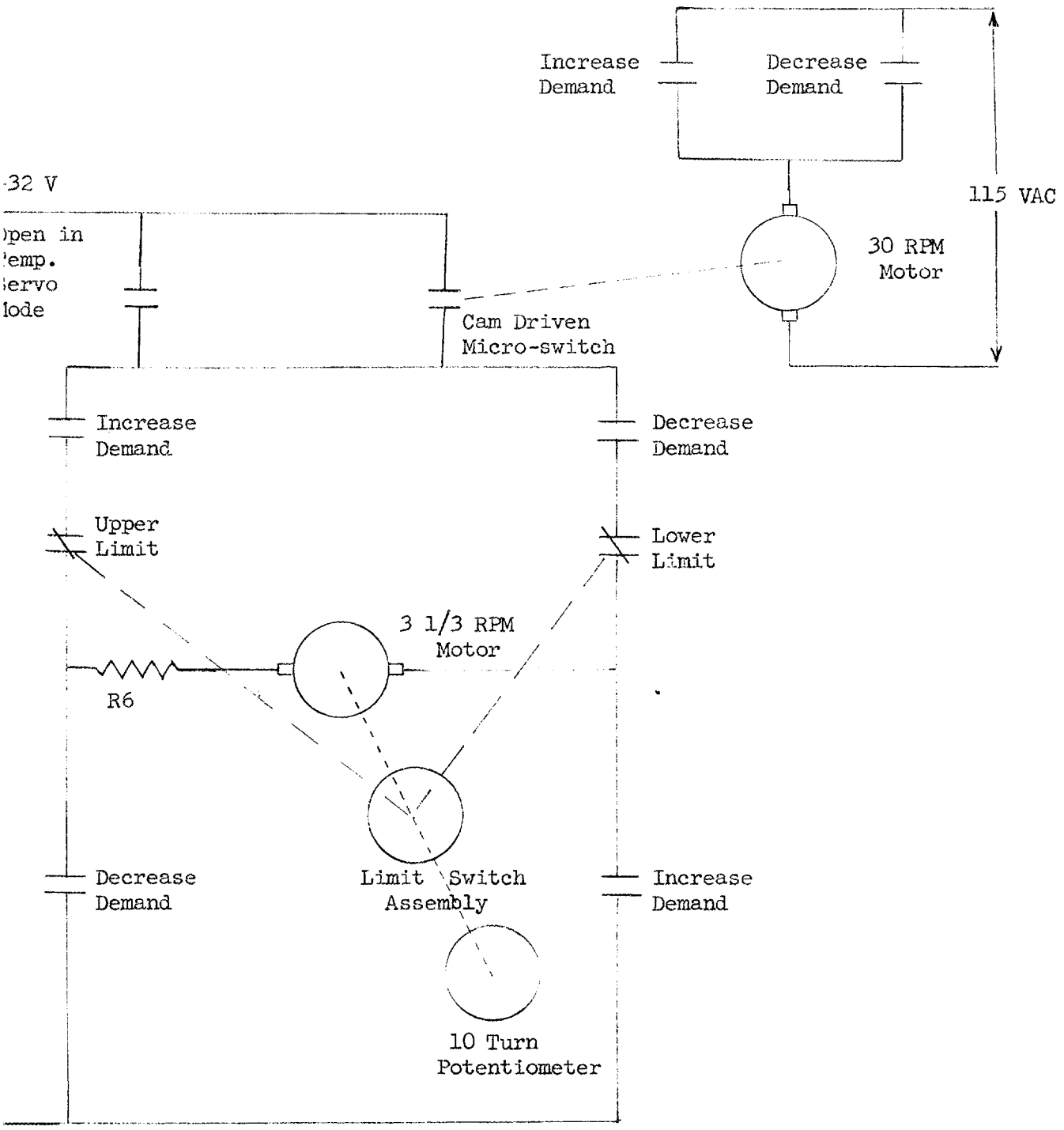


Fig. 2. Temperature Servo Demand Drive.

Table 1. Replaceable Parts List

Part No.	ORNL Stores No.	Description
		Gear, stainless steel, 60 teeth, 48 pitch, 1/8 in. face and bore, 1.25 P.D., PIC Design Corp. catalog No. G61-60.
		Miniature slip clutch assembly, PIC Design Corp., catalog No. R3-11.
		Gear, stainless steel, 60 teeth, 48 pitch, 1/8 in. face, 3/8 in. bore, 1.25 P.D., PIC Design Corp., catalog No. J1-60.
	06-077-2850	Timer, repeat cycle, adjustable cam, with 1 each spdt precision snap switch, 60 cycle timing motor, 1 rev per week, Haydon Mfg. Co., No. RB21. Replace existing motor with 30 rpm motor below. Modify the cam as shown in ORNL Instr. Dept. drawing No. Q-2628-2, detail 7.
		Motor, heavy duty, Haydon series MP-10, (30 oz-in. torque at 1 rpm) 30 rpm, 120 v, 60 cycles, clockwise rotation, No. 5186 shaft, must operate in 55°C ambient temperature.
M1	06-050-1835	Meter, 0-50 μa dc, 1175 ohm coil, accuracy ±2% full scale, Weston No. 206-5601101, mark scale per ORNL Instr. Dept. drawing No. Q-2628-7.
R6		Resistor, 130 ohms, ±5%, 1 w, A-B.
R2	06-932-0175	Resistor, 50 kilohms, ±1%, 1/2 w, Stemag, type SLAK.[1]
R5	06-932-0199	Resistor, 200 kilohms, ±1%, 1/2 w, Stemag, type SLAK.[1]
R1	06-932-0205	Resistor, 250 kilohms, ±1%, 1/2 w, Stemag, type SLAK.[1]
R3	06-932-0251	Resistor, 1 megohm, ±1%, 1/2 w, Stemag, type SLAK.[1]
		Direct current motor, type SS, with planetary gear reducer, Globe Industries, Inc., Part No. 43A151-5, 27 v, integral gear reducer, 1853-to-1 reducer, ball-bearing output shaft, 1-3/8 in. diam by 3-1/8 in. long. C/W noise filter, Globe, No. 40-S-252.

Table 1 (continued)

Part No.	ORNL Stores No.	Description
		Miniature adjustable limit switch and stop, 0 to 25 revolutions, Precision Mechanisms Corp., model LS-302.
		Potentiometer, 500 ohms, 10-turn, ±3% resistance tolerance, ±0.25% linearity tolerance, servo mount with ball bearings, Helipot, model 7223.

[1]All carbon film resistors, "Stemag," are double high-temperature varnish impregnated. Vendor: H.E. Priester Corp., Scarsdale, N.Y.

6. ACCEPTANCE TEST PROCEDURES

6.1 Test Equipment

The following test equipment is required:

1. One power supply, 32 v dc, 1 amp.
2. One power supply, 10 v dc, 5 ma.
3. Triplett Meter (model 630), or equal.

6.2 Adjustment Procedure

The adjustment procedure is as follows:

1. Mechanically zero the front panel meter.

2. Remove the gear from the rotary limit-switch assembly. Position the potentiometer shaft until the resistance between pin T and N is zero. Position the rotary limit-switch shaft until the lower limit switch (pins B and F) just opens. (In the following range adjustment procedure, clockwise and counterclockwise directions are viewed from the adjusting screw end of the limit-switch assembly. It should be noted that range adjustment affects the clockwise shaft limit only.) Replace the gear on the rotary limit-switch assembly.

3. Loosen the lock nut at the end of the unit just enough to allow rotation of the adjusting screw. Rotate the adjusting screw clockwise as far as it will go; the unit is now set for zero shaft rotation. Rotate the adjusting screw counterclockwise for 6-2/3 turns. Tighten the lock nut in place. The unit should now be adjusted to limit the travel of the potentiometer to 6-2/3 turns, or a full-scale output of 6.66 v. To check this calibration, apply +10 v to pin X with return on pin N. The voltage measured from pin T to pin N should be zero. Rotate the gear on the motor clockwise (as viewed from the shaft end) until the upper limit opens (pins U and V). The voltage should now measure 6.66 v. If it does not, readjust the rotating limit switch.

4. Adjust the cam on the ac motor until the microswitch is dropped out for approximately 18° per revolution.

5. Connect the limit switches and the microswitch in series with the dc motor, with the microswitch closed. If necessary, rotate the motor gear by hand until both limit switches are closed. Apply 32 v to this series arrangement and measure the rate of change of output voltage. The output should change 3.33 v/min; it should take 2 min to drive full scale (this rate may be changed by changing resistor R6).

6. To measure the slow rate of change, apply 115 v ac to pins K and J so that the dc motor drives only when the microswitch is dropped out. The rate of change of the output should now be 0.167 v/min. Readjust the cam until this rate is achieved.

ORNL-TM-1638
Part 28

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