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NUCLEAR INSTRUMENT MODULE MAINTENANCE MANUAL

PART 27

SYNCHRONOUS DEMODULATOR, ORNL MODEL Q-2627

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ABSTRACT

The circuit, application, and maintenance instructions for a synchronous demodulator are described. The circuit is constructed in a "2-unit" module of the ORNL Modular Reactor Instrumentation series Q-2600, and is intended for use in control systems of reactors employing this series of instruments.

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1. DESCRIPTION

1.1 General

The Synchronous Demodulator is designed to produce a dc voltage whose magnitude is proportional to the magnitude of the ac input voltages and whose polarity is determined by the phase of the input ac voltage.

1.2 Construction

The Synchronous Demodulator is constructed 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 drawings Q-2600-1 through Q-2600-5.

The circuit is constructed on a printed circuit board. A potentiometer is mounted on the module to provide adjustment of the output voltage.

1.3 Application

The Synchronous Demodulator is intended to convert the output of an ac tachometer to a direct current. A typical application would be a servo which has a dc error amplifier and an ac motor and tachometer. Therefore, it is necessary to rectify the tachometer output before it can be fed back to the error amplifier. Since negative feedback is always required, the output of the synchronous demodulator must change polarity when the direction of rotation is reversed.

1.4 Specifications

- | | |
|---|--|
| 1. Output voltage: | 1.5 v dc for 45 v peak-to-peak sinusoidal input. |
| 2. Output ripple: | less than 30 mv peak to peak at 120 cps. |
| 3. Response time to 63% of final value: | less than 30 msec. |
| 4. Ambient temperature range: | 0 to +55° C. |
| 5. Output current: | 0.15 ma into 10-kilohm resistor. |

1.5 Applicable Drawings

The following list gives the drawing numbers (ORNL Instrumentation and Controls Division drawing numbers) and subtitles for the Synchronous Demodulator:

- | | | |
|----|-----------|------------------------|
| 1. | Q-2627-1 | Circuit. |
| 2. | Q-2627-2 | Details. |
| 3. | Q-2627-3 | Metalphoto Panel. |
| 4. | Q-2627-4 | Printed Circuit Board. |
| 5. | Q-2627-5 | Assembly. |
| 6. | Q-2627-6. | 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

A schematic diagram is shown in Fig. 1. This circuit is a full-wave demodulator, and its operation is as follows. The ac reference signal is assumed to be very much larger than the input signal. Therefore, for the half cycle during which point d is positive and point b is negative, the lower two diodes conduct and the upper two are reverse biased. If the secondary of the reference is accurately center-tapped, and if the impedance of the paths bc and cd are exactly the same, then point c will be at ground potential. The output will be the voltage that appears between the center tap of the input transformer secondary and point c. During the next half cycle, point b is positive and point d is negative, causing the upper two diodes to conduct; the output is the voltage between the center tap of the input transformer secondary and point a. The circuit acts as a switch, making point a or point c at ground potential in synchronism with the reference signal.

The resistances R are required to limit the current flowing in the diodes due to the reference voltage. The rectified output is filtered to provide a smooth output voltage.

3. OPERATING INSTRUCTIONS

3.1 Installation

The Synchronous Demodulator is a module in the ORNL Modular Reactor Instrumentation series. Like the other modules of the 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.

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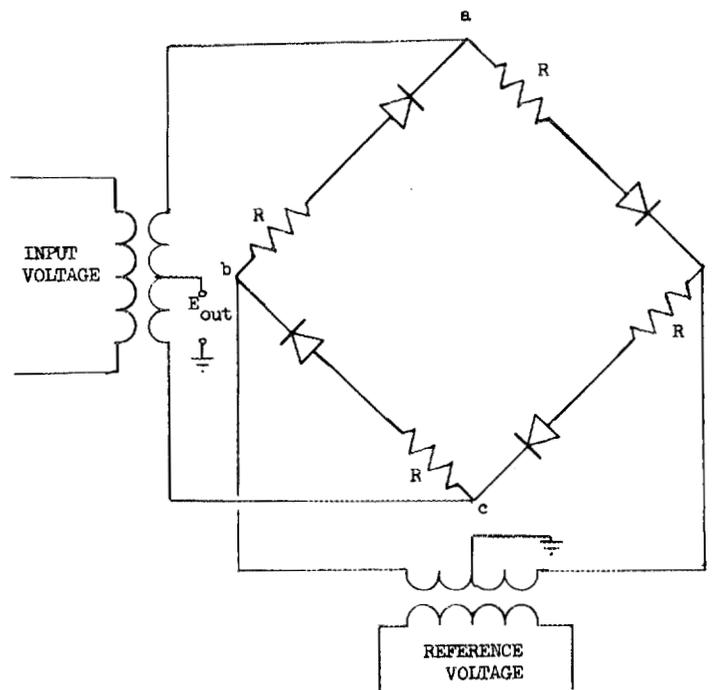


Fig. 1. Synchronous Demodulator.

3.2 Connections

All connections are made through the rear connector P25 when the module is inserted.

4. MAINTENANCE INSTRUCTIONS

4.1 General

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

4.2 Trouble Shooting

All small components are soldered to the printed circuit board; soldering repairs should be made carefully to avoid damage to the printed circuit board and components.

Typical voltages and waveforms are listed below for comparison purposes only.

1. Input voltage: primary, 45 v peak to peak, 60 cps; secondary, 70 v peak to peak, 60 cps.
2. Reference voltage: primary, 320 v peak to peak, 60 cps; secondary, 108 v peak to peak, 60 cps.
3. Filter input voltage: 5.5 v dc; 4 v peak to peak, 120 cps ripple.
4. Output voltage: 1.5 dc; 4 v peak to peak, 120 cps ripple.

If the impedances in the bridge legs should become unbalanced, the result would be an output voltage with no input. This can be corrected by replacing the faulty diodes and resistors.

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

<u>Part No.</u>	<u>ORNL Stores No.</u>	<u>Description</u>
R1, T2	06-982-3220	Transformer, input, interstate, 15-kilohm primary impedance, 80-kilohm secondary impedance, UTC No. A-18.
C1, C2	06-802-0091	Capacitor, 2.2 mf, $\pm 20\%$, 25 v dc w, monolithic, ceramic, Sprague No. 5C15.
R4	06-930-1120	Potentiometer, ww, 1000 ohms, $\pm 3\%$, 2 w, linear tolerance 0.2%, 10-turn, Bourns No. 3500S-2-102.
R5, R6, R7, R8	06-936-0690	Resistor, 4000 ohms, $\pm 1/2\%$, 3/4 w, ww, noninductive, Daven type 1252.
R1, R2, R3		Resistor, 1000 ohms, $\pm 5\%$, 1/2 w, A-B.
D1, D2, D3, D4	06-995-5690	Diode, type 1N270, Transitron.

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