Westinghouse

A311 THYRISTOR GATING MODULE

I. General Description

The A311 gating module produces phase controlled pulses to fire thyristors. Two pulses, at the same phase angle, are provided from isolated outputs for each cycle of the supply voltage.

The phase angle (φ) of the output pulse can be shifted with respect to the synchronizing supply voltage by a d-c input voltage.

The module, shown in Figure 1, consists of one printed circuit board mounted in a metal enclosure. All connections to the module are made to screw type terminals on the face plate of the enclosure.

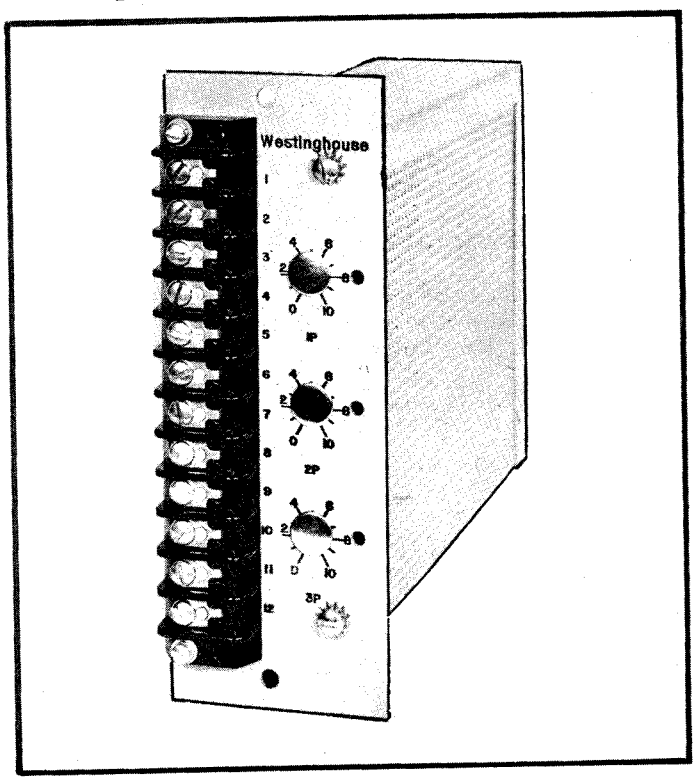

FIGURE 1 - A311 THYRISTOR GATING MODULE

II. Scope of Application

The A311 gating module will control thyristors up to size 9 (250 ampere) in multi-phase rectifier type thyristor power amplifiers.

III. Specifications and Ratings

Ambient Temperature:	0 to 50°C.	
Power Requirements:	115 VAC ± 10%,	approx. 220 mA
	Supply frequency:	62 cps to 48 cps
Input Voltage (V_{1-2}):	(-)2 to 50 volts d-c	

Transfer Curve:

Gain: 14 degrees/volt

Maximum shift of the transfer curve due to line voltage variations of ± 10%: less than ± 2 degrees.

Maximum shift of the transfer curve due to frequency change from 62 cps to 48 cps: less than + 3 degrees.

Response:
One cycle maximum

Output Pulse:
Rise Time:
approximately 10 μs
Pulse Width:
4.2 ms ± .8 ms, independent of thyristor gate characteristics.
Pulse Amplitude:
2 to 5 volts
This value is only approximate and depends on gate circuit components and thyristor gate characteristics.
Phasing:
Terminals 3 and 5 are pulsed positive during the half cycle when terminal 11 is positive.

Refer to Figure 2 for phase relations and wave shapes.

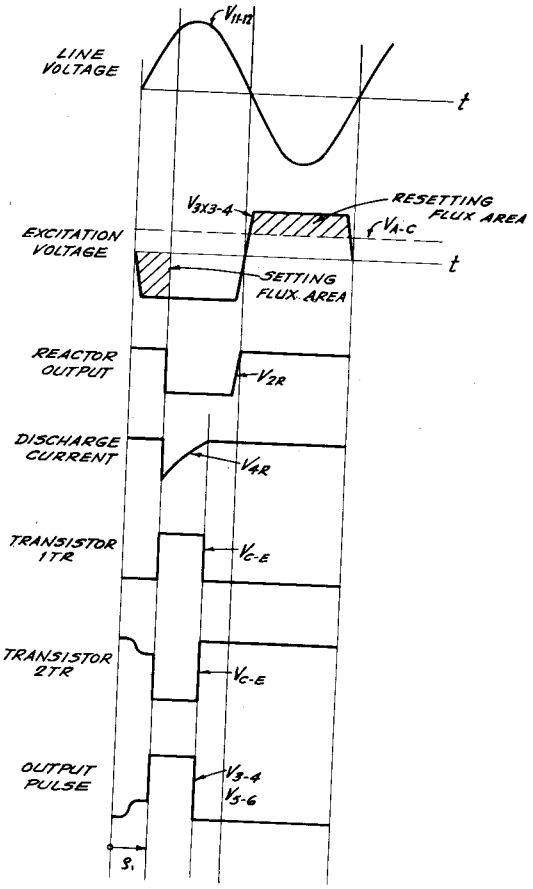

FIGURE 2 - WAVE FORMS

IV. Description of Operation

The operation of the A311 gating module will be described with reference to the schematic diagram, Figure 3, and the wave shapes in Figure 2.

A flux reset magnetic amplifier is used as a phase shifter. Reactor 1X is excited by a square wave produced from the line voltage (V_{11-12}) by a zener clipper circuit consisting of resistor 9R, the isolation transformer 3X, a diode bridge 7D to 10D, and zener diode 11D. With no input voltage (V_{1-2}), the reactor is capable of absorbing the full excitation voltage ($V_{3X3-3X4}$).

If the input voltage is other than zero, the reset voltage ($V_{3X3-3X4} - V_{1-2}$) is smaller than the setting voltage and saturation of the core will occur before the end of the half cycle. The phase angle (φ) at which saturation occurs, therefore, is controlled by the input voltage.

When reactor 1X saturates, it produces a pulse across resistor 2R which is coupled to the base of transistor 1TR, driving the otherwise saturated transistor into cut off. As the collector voltage rises, it turns on the output transistor 2TR placing the zener clipper voltage (V_{P-N}) across the primary of transformer 2X. The output pulses appear across each of the secondary windings of transformer 2X, terminals 3, 4 and terminals 5, 6.

Approximately 4 ms later, capacitor 1C is charged sufficiently to turn on transistor 1TR which turns off transistor 2TR. The current in the primary of transformer 2X will commutate to the diode network 4D, 5D allowing the transformer to reset.

Capacitors 2C and 3C, across the outputs, improve the dV/dt characteristics of the thyristor and absorb noise picked up in the gate leads to the thyristor.

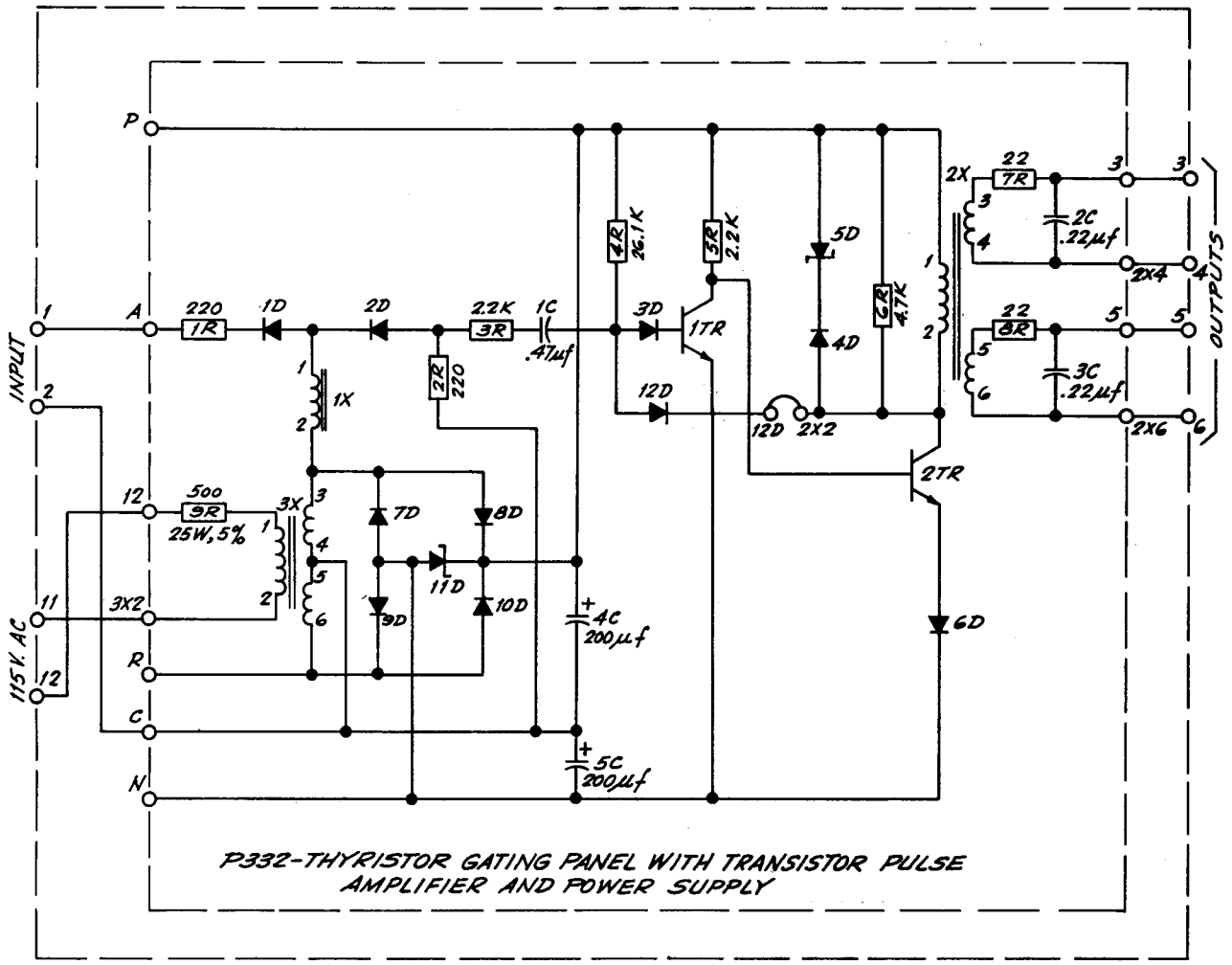

FIGURE 3 - SCHEMATIC DIAGRAM

V. Service

Proper operation of the A311 gating module is insured as long as the components remain within design specifications. If a failure in the gating module is suspected, compare the supply voltage and output pulse wave shapes with those given in Figure 2. If the output pulse is not satisfactory or the phase angle (φ) does not shift when the input voltage is changed, replace the module with the recommended spare while the defective unit is being repaired as outlined below.

VI. Repairing the Module

To service the module after it has been removed from the control panel requires the following:

1. A sinusoidal wave shape of 115 VAC applied to terminals 11 and 12.
2. A variable d-c supply from 0-10 V at terminals 1 and 2.
3. An output load on terminals 3, 4 and 5, 6 that simulates the thyristor gate as shown below:

R = 22 OHM

Normal trouble shooting procedure, using wave forms shown in Figure 2, should readily isolate the defective component. If a magnetic component should fail, it is recommended that the unit be returned to Westinghouse Electric Corporation, Systems Control Division, Buffalo, New York for servicing.

VII. Spare Parts

To keep the down time of the control system to a minimum should a gating module fail, it is recommended that a spare module be available for immediate replacement. If the size of the installation will warrant, one spare gating module should be available for every ten modules used in the control system.

A parts list of the equipment can be obtained through your nearest Westinghouse District Sales Office.