TYPES WT-1 AND WT-2

IMPULSE TOTALIZING RELAYS

General

The types WT-1 and WT-2 impulse totalizing relays provide a means of totalizing impulses from several circuits and providing output impulses in proportion to the total input. The WT-1 relay has a 6 digit output counter which gives the total impulses retransmitted. The WT-2 relay has a 6 digit counter on each input circuit as well as an output counter. Both relays have plug-in printed circuit boards and a time delay relay to prevent transmission of spurious impulses following a power outage.

Both units are built in switchboard flexitest cases for projection or semi-flush mounting. The WT-1 relay uses an FT-32 case and the WT-2 uses an FT-42 case.

Application

The WT-1 and WT-2 relays can be operated from any 3-wire mechanical contactor such as the Westinghouse CD-3 contact device or the Westinghouse CV-1 electronic impulse generator whose output is a relay with mechanical contacts. These contacts should be electrically isolated and not used to operate other apparatus. An external power source is not required for each input channel since power is derived from the 120 volt, 60 cycle supply to the relay.

Three, five, and seven channel inputs are provided with input to output ratios of 1:1, 2:1, and 4:1. The use of 1:1 ratio with more than 3 channels is not recommended.

Unless otherwise specified, relays will be supplied with a maximum output rate of 56 impulses per minute. This rate provides a minimum output relay closure of 32 cycles.*

The formula for determining maximum input impulse rates is thus:

$$\text{Impulses per minute} = \frac{56 \times \text{Input/Output Ratio}}{\text{No. of Input Channels}}$$

* 60 Cycle Base

The following table gives the maximum input rates per channel in impulses per minute:

Number of Input Channels	Input to Output Ratio	Maximum Input Rates Per Channel-Impulse per Min. Output Rate - Impulses per Minute			
		56△	112	225	450
3	1/1	18	37	75	150
	2/1	37	75	150	300
	4/1	75	150	300	600
5	1/1	11	22	45	90
	2/1	22	45	90	180
	4/1	45	90	180	360
7	1/1	8	16	32	64
	2/1	16	32	64	128
	4/1	32	64	128	257

It should be recognized that the output relay closure time will be reduced in direct proportion to the increase in output impulse rate.

Input channels are responsive only to a complete 3 wire impulse, in other words, two contacts received on different channels will not add up to deliver one 3 wire output impulse. On a relay with an input/output ratio of one to one, only 3 wire impulses will be transmitted. Relays with 2 to 1 or 4 to 1 ratios will transmit a pulse at a time. For example with a 2 to 1 ratio, a complete 3 wire impulse at one input may cause a closure of the output relay and the next completed 3 wire impulse on the same or another channel will cause the output relay to open.

Special Note

WT-1 and WT-2 relays can be provided to respond to pulses instead of impulses, however, both input and output counters still will count impulses. Such relays should be negotiated.

Figure 1 is a block diagram of a five channel WT-2 impulse totalizing relay. It is seen that there are five channel boards, one for each meter input: an output board, and a "clock" board.

The small blocks represent individual function circuits.

△ Standard rating supplied unless otherwise negotiated.

Operation

Nearly all of the functions in the WT-1 and WT-2 are performed by a bistable circuit, or "flip-flop" consisting of two transistors with appropriate feedback. A typical circuit of this type is shown in Figure 2. This circuit has two stable conditions, (1) with the left hand transistor conducting and (2) with the right hand transistor conducting. As long as sufficient drive is provided to the "ON" transistor and adequate bias applied to the "OFF" transistor the circuit will remain in either state.

The "set" and "reset" inputs may be fed from different sources so that a certain sequence of events must occur to produce an output pulse, or the "set" and "reset" lines may be tied together. In this latter case the circuit will transfer from one state to the other with each input pulse, hence the term "flip-flop." In either arrangement only one output pulse will be produced for a complete cycle of a "set" pulse and a "reset" pulse. This requirement of two input pulses for each output pulse also classifies the circuit as a "Binary" or a 2:1 divider.

The circuit may be combined in a number of ways to perform many useful functions. For example, the channel board shown in Figure 3 contains three of these to perform the three functions of input, storage and interrogation. The left hand pair of transistors comprise the input circuit which consists of a flip-flop with separate "set" and "reset" terminals. This circuit element makes it necessary to energize one contact and then the other of a 3 wire contact device to obtain an output pulse. The input counter is operated by the pulse to terminal A.

The output pulse from the input section places the storage circuit in the "Set" or "Stored" condition. If the storage circuit has been "set" it will deliver a pulse to the output when it receives a "reset" pulse from the interrogation circuit. By regularly and sequentially interrogating the storage circuits a string of non-coincident pulses is generated with one output pulse for each input pulse if the input pulse rate does not exceed the interrogation rate.

The interrogation circuits of all channel boards are interconnected to form a ring counter. In a ring counter one of the stages will differ in state ("set" or "reset") from all the others and, by suitably driving the counter, the unique state may be caused to progress from stage to stage. As it progresses, the storage sections are interrogated or "scanned" in sequence. Referring to Figure 3 it will be noted that a resistor R-2 is terminated between the two terminals L and R of the interrogation circuit. To set up the unique state of one counter stage this resistor is connected to L on one board while on all remaining boards it is connected to R. The "ring" is established by connections from "F" of each circuit to "P" of the following board.

The pulses used to drive the ring counter are obtained from a pulse generator or "clock" board which contains a pulse squaring stage fed by 60 cycles from the power transformer, and a chain of six binary divider stages. The ultimate output is a square wave with a frequency of 15/16 cycles per second. Higher frequencies are also available from intermediate stages of the divider and are used as will be described later. When the 15/16 cycle frequency is used to drive the ring counter one storage section is interrogated every 64 cycles* providing a maximum output rate of 56 impulses per minute.

The output circuit shown in Figure 4 is used to drive the output relay in response to pulses from the channel storage sections. It is a modified flip-flop and may be connected for two different modes of operation. First, when connected to deliver one relay operation for each stored pulse, the circuit is "set" by a pulse from the storage sections, closing the relay. It remains in this state for one half cycle of the interrogating frequency and is then reset (releasing the relay) by a squared wave 180° out of phase with the interrogating frequency.

For the second mode of operation the output circuit is "set" and "reset" in sequence by pulses from the storage sections. Thus, two input impulses are required to deliver one output impulse, causing the relay to have a 2:1 input/output ratio. To maintain a 32 cycle (60 cycle base) relay closure the storage sections are interrogated by the 1 7/8 cycle frequency from the clock.

A 4:1 input/output ratio is made available by adding an additional binary stage to the output circuit. This permits interrogation at 3 3/4 cycles for the same chosen output rate.

The output relay used is a double-pole, double-throw, one pole used for transmitting the output pulse and the other pole used to operate the output counter.

The power supply is straight-forward and consists of a 120/50 volt center tapped power transformer followed by a full wave silicon rectifier and capacitive filter.

When the WT-1 or WT-2 relays are de-energized such as during a power outage and then re-energized, the flip-flops can assume either of their two stable conditions at random. Since one position of the flip-flops on the input boards represents a stored pulse, immediate scanning and transmission could result in false impulses being sent out. To prevent this, a time delay relay is inserted in the output relay circuit to allow all stored pulses to be swept out before the output relay is reconnected. This may result in losing pulses stored

* 60 Cycle Base

at the start of the power outage and pulses received immediately after power is restored, but no false pulses are created.

The physical arrangement of the circuit boards is starting from top to bottom, the top two boards are clock boards, the third one is the output board, and the remaining 3, 5, or 7 boards are input circuit boards.

Operating Characteristics

Supply - - - - - - 120 V. A.C., 60 Cycle

Burden - - - - - -	WT-1	WT-2	Input Channels
	16	35	3
	22	50	5
	27	65	7

FIGURES

1. Block Diagram of WT-2
2. Typical Flip-flop
3. Input circuit
4. Output circuit
5. External Wiring Diagram (283A653)
6. Outline and Drill Plan WT-1 (511C010)
7. Outline and Drill Plan WT-2 (511C226)
8. Wiring Schematic (110C470)

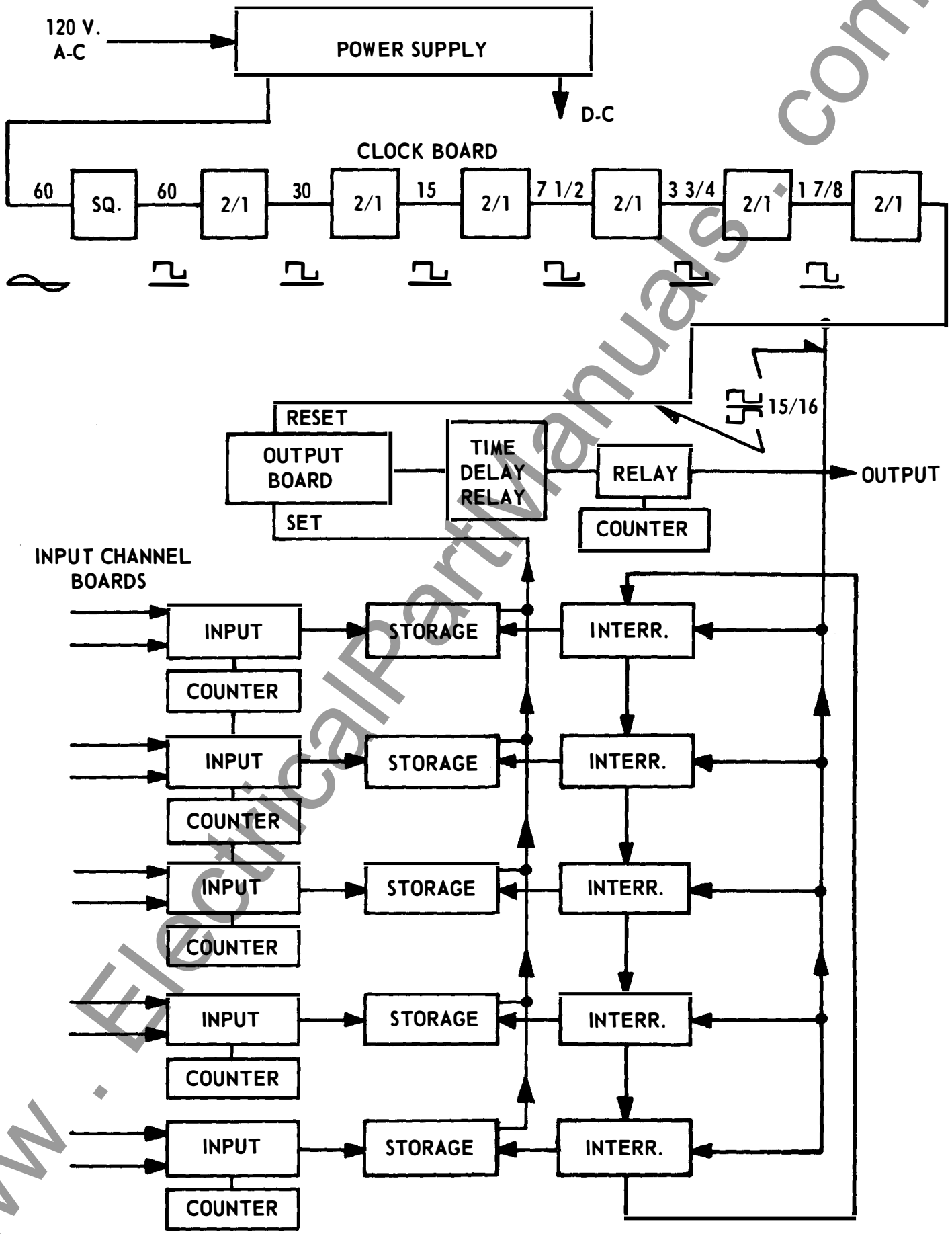


Fig. 1

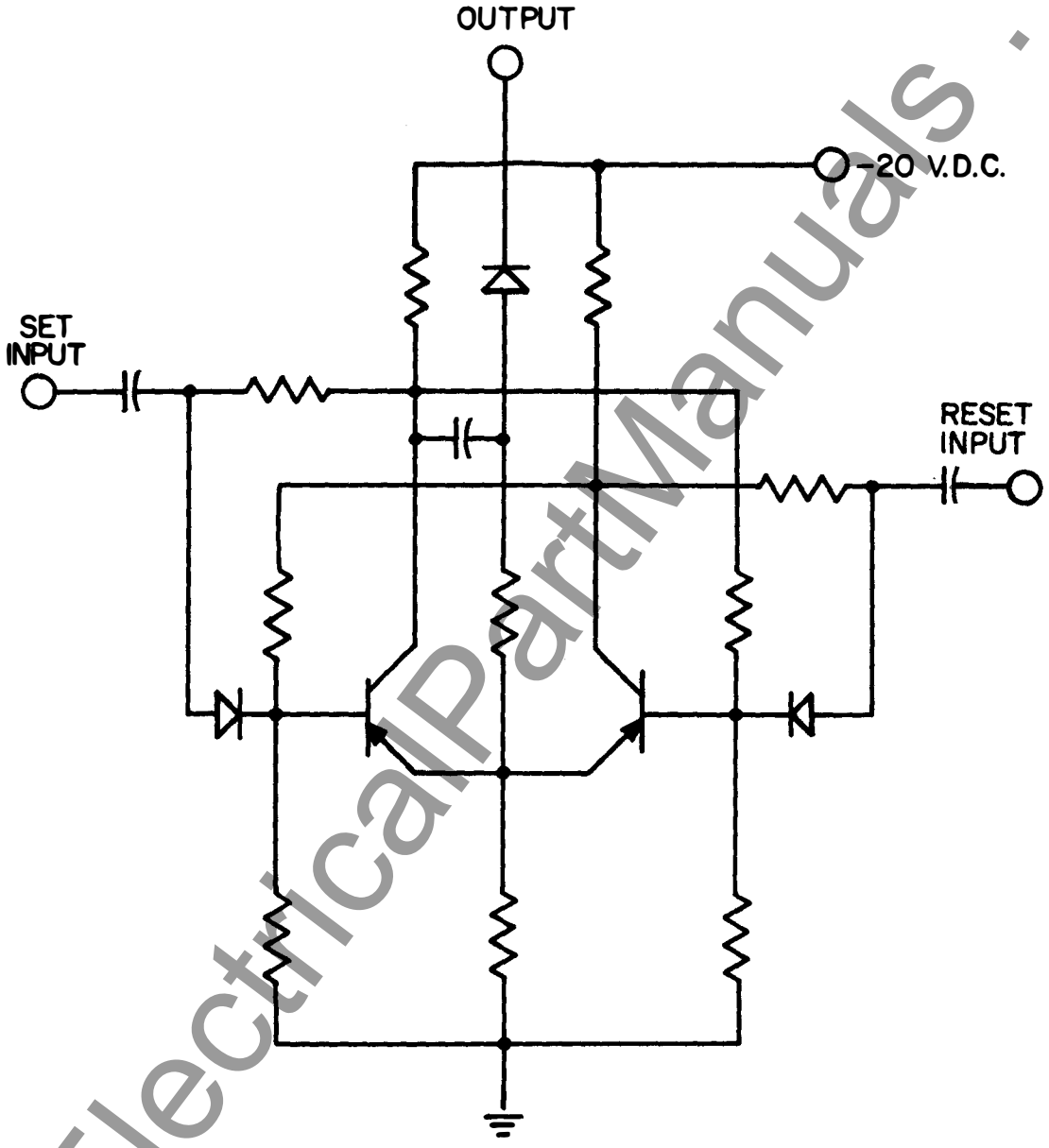


Fig. 2

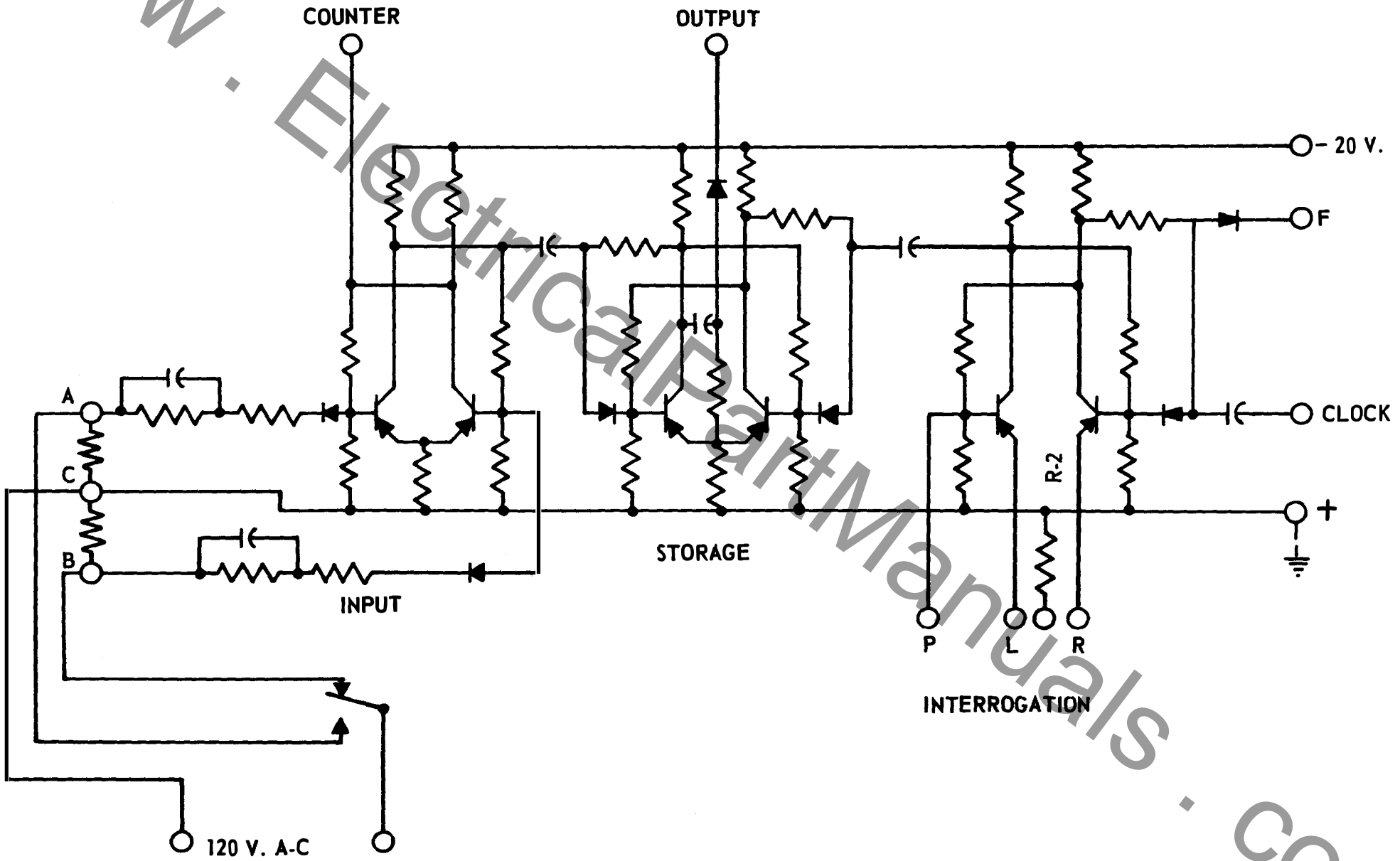


Fig. 3

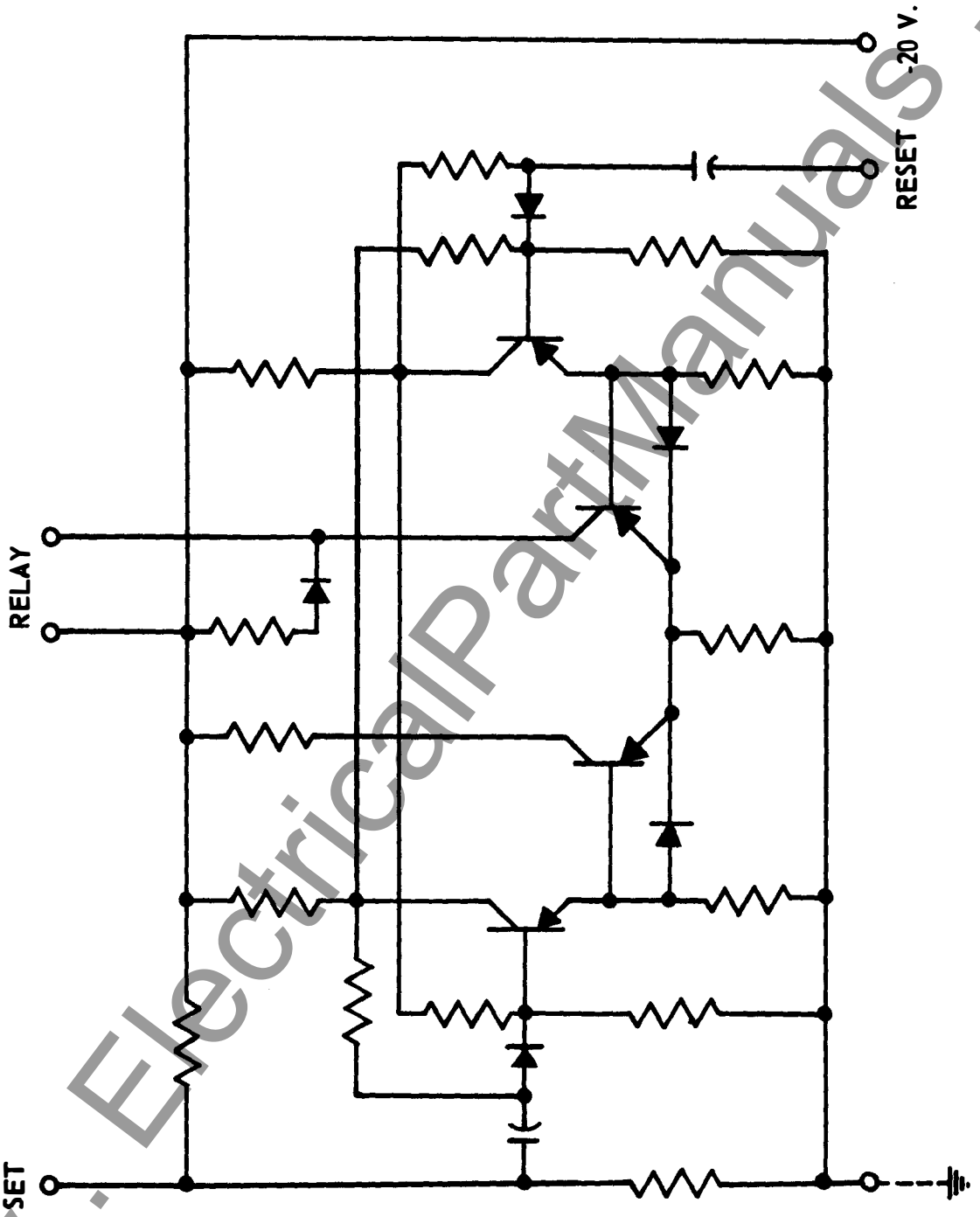
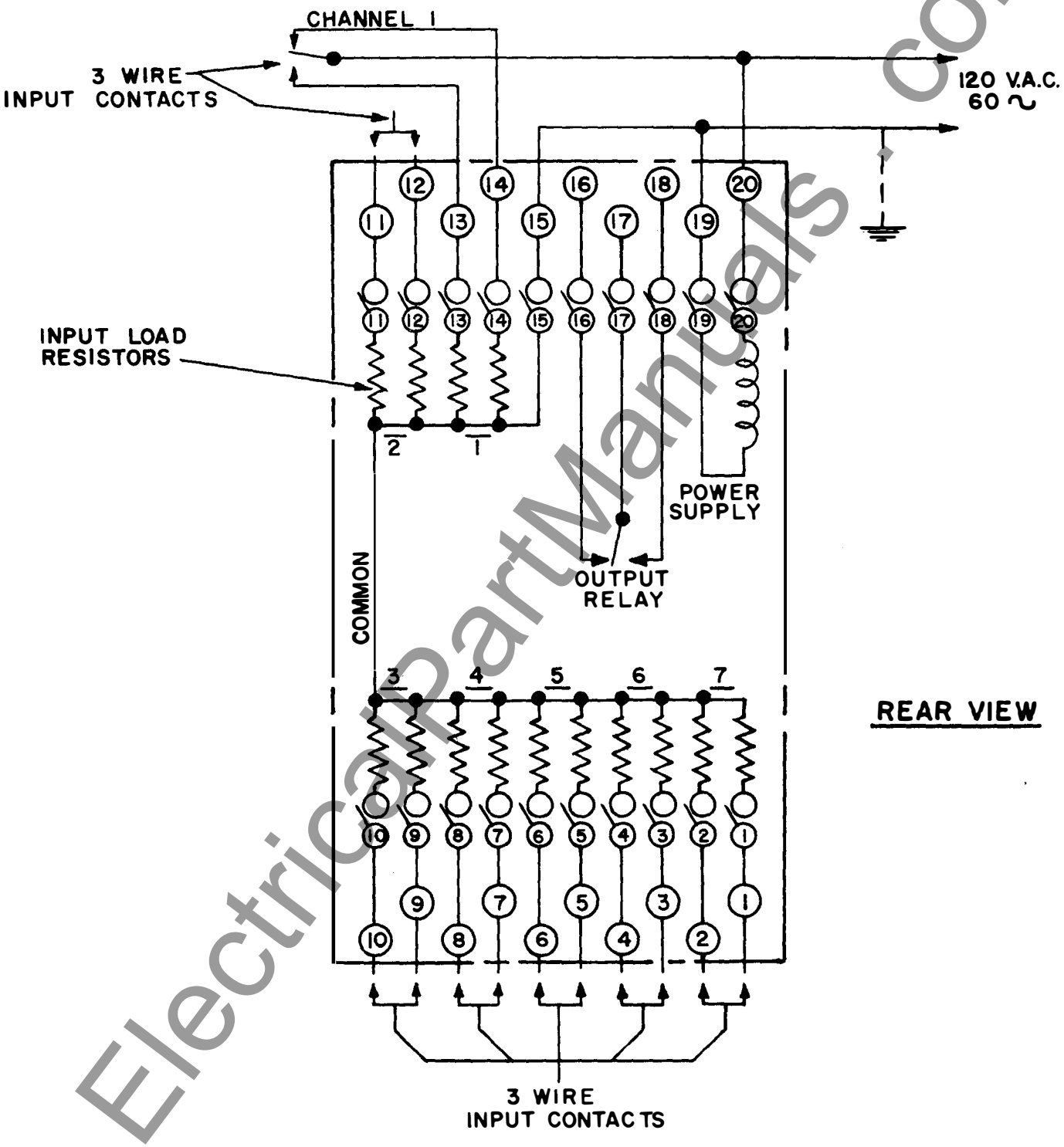
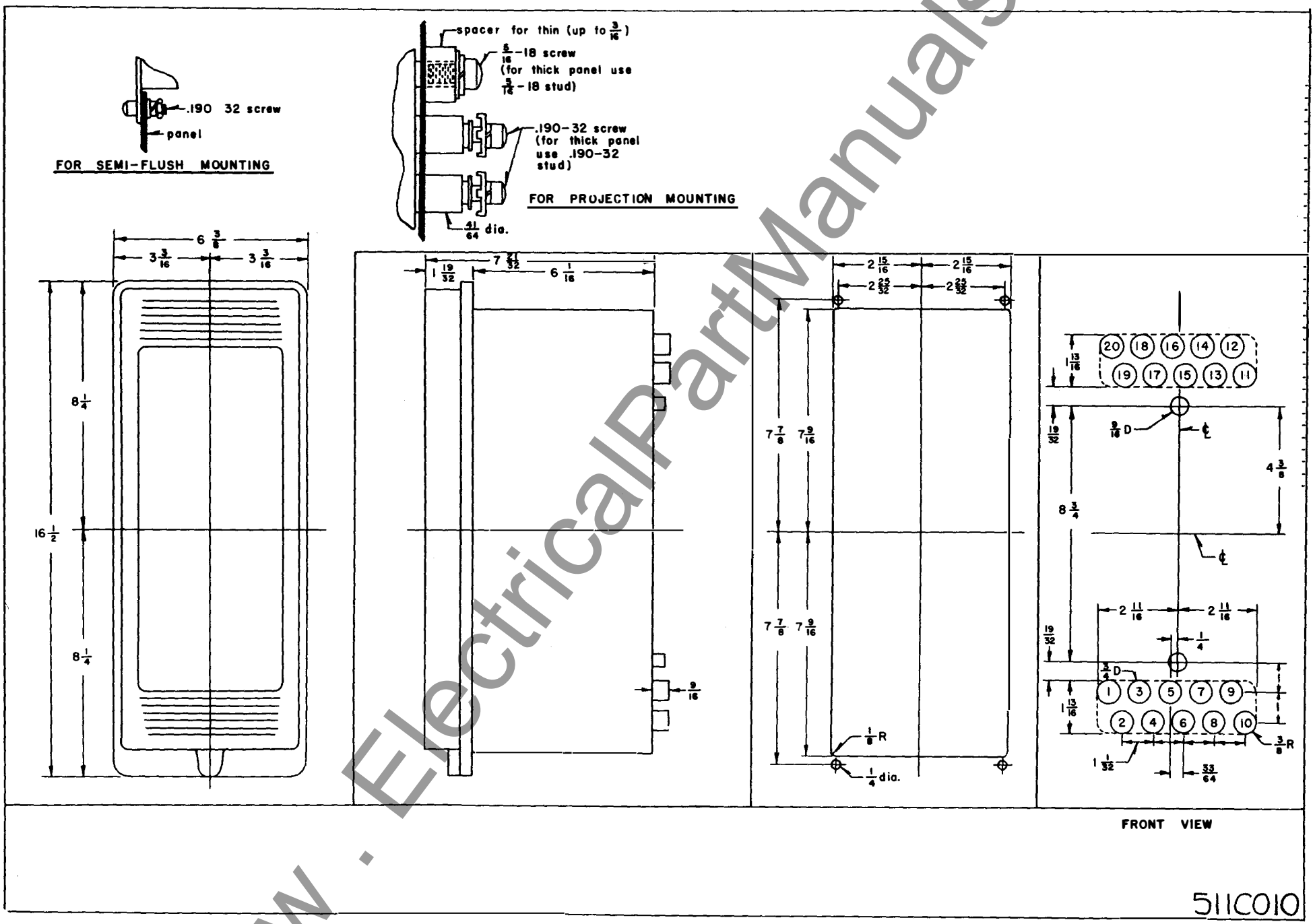
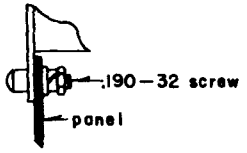


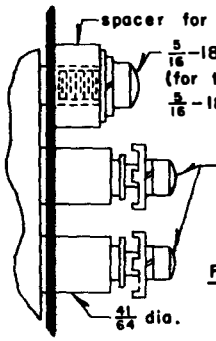
Fig. 4





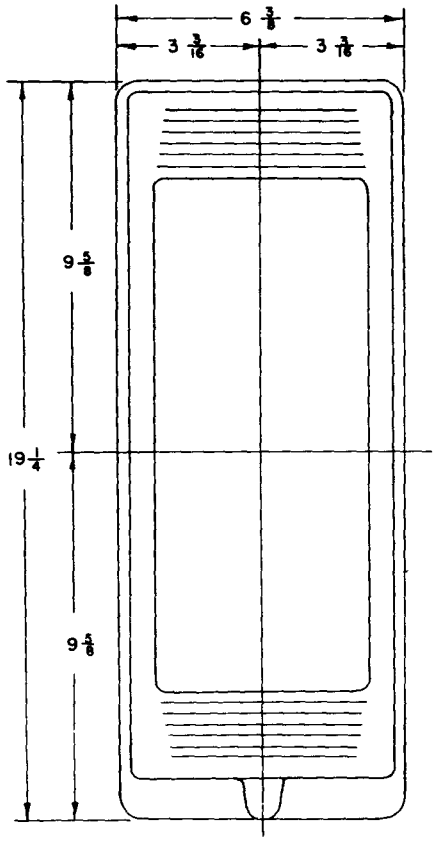


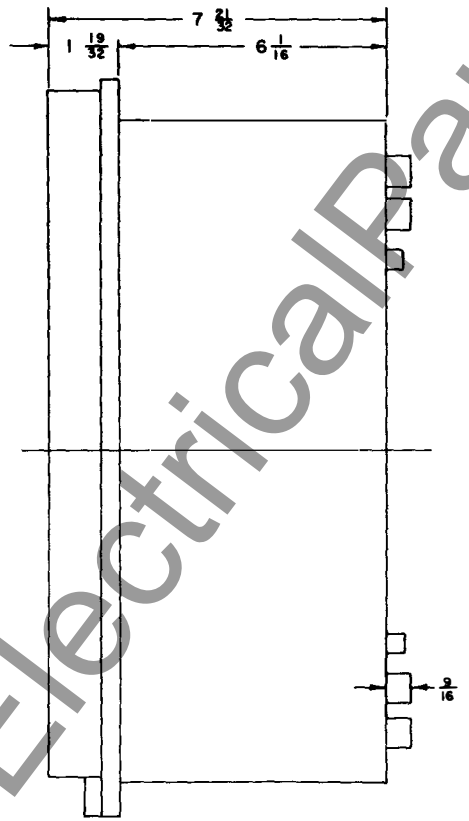
FOR SEMI–FLUSH MOUNTING



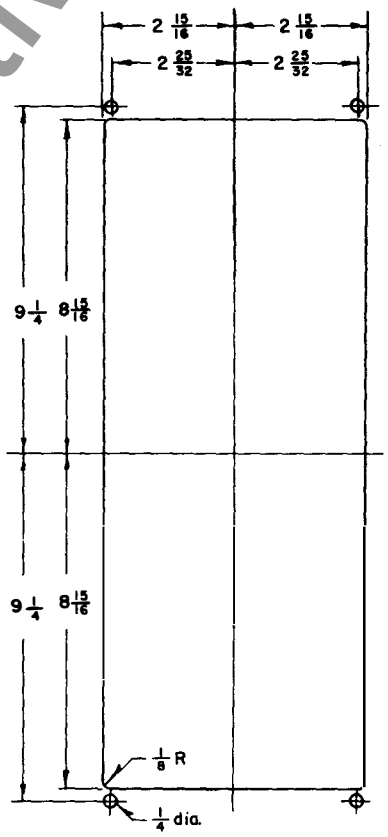
FOR PROJECTION MOUNTING

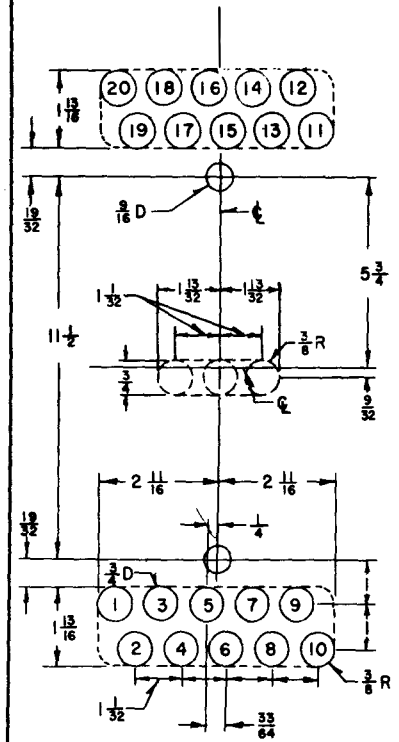
FRONT VIEW





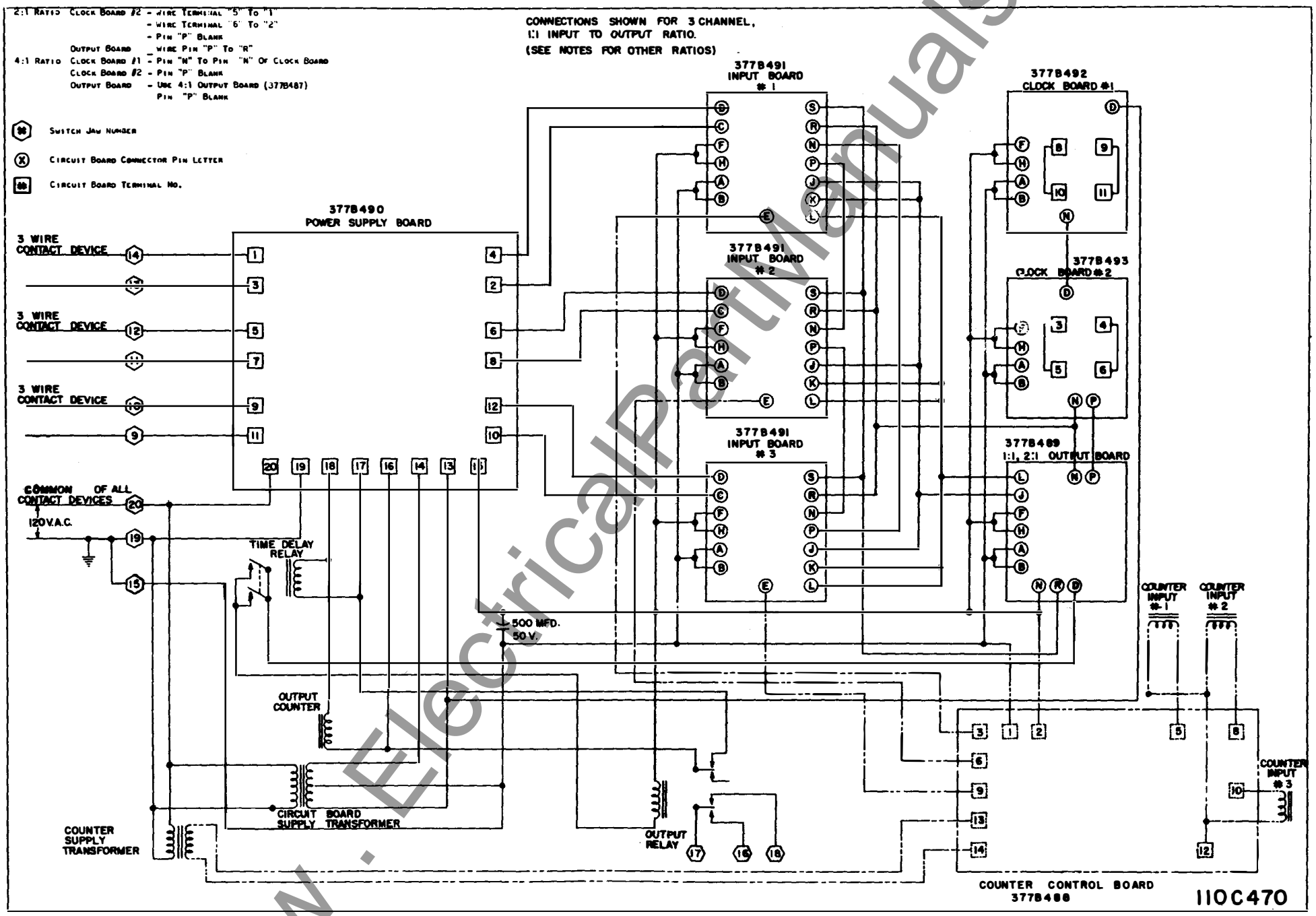
CASE DIMENSIONS IN INCHES





PANEL CUTOUT DIMENSIONS IN INCHES

511C226



Special WT-2 Totalizing Relays
Modified for Pulse Operation

To modify the standard WT-2 impulse totalizing relay to operate on pulses required a slight change to the input circuit boards for each input channel. The only difference between the two is that the pulse type input board has two outputs from the input flip-flop coming into the storage flip-flop. This means that the storage flip-flop will receive an input pulse each time the input flip-flop changes state instead of every other time. Thus for each contact closure made by the 3 wire input device, the input flip-flop will change state and transmit a pulse to the storage flip-flop. The input and output counters, however, will only count impulses and therefore must be multiplied by two to give correct totals. The style number of these special input boards is 377B607G01.

To achieve pulse operation on the output of the WT-2, the output circuit is modified somewhat from that of an impulse totalizer. For example, for a 1:1 ratio pulse operated WT, the output circuit board required would be the one which is normally used on a 2:1 ratio impulse WT. Similarly for a 2:1 ratio pulse operated WT, the output board required would correspond to the one used on a 4:1 ratio impulse unit. For a 4:1 ratio pulse operated WT, however, a special output board is required which if used in an impulse unit would give an 8:1 input/output ratio. The style numbers for these various output boards are given below:

Input/Output Ratio (Pulse Operation)		Output Board Style
1.	1:1	377B447G01
2.	2:1	377B448G01
3.	4:1	377B636G01

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