



142 SIERRA ST., EL SEGUNDO, CALIFORNIA 90245 (310) 322-2136

## ES-165

### Operation and Maintenance Manual

The ES-165 is a master impulse driver that is designed to drive the ES-168 impulse clock. It is capable of driving up to 50 impulse clocks wired in parallel. If AC power fails, the clocks will continue to run from internal battery power for at least 12 hours. Driving fewer clocks will result in longer battery life under power fail conditions. A battery switch and fuse (2 amp) are located on the front panel; the unit is shipped with this switch in the "Off" position. An "On/Off" switch for the impulse output is also located on the front panel. The ES-168 impulse clocks can be set as follows: turn the impulse driver output "On". Each ES-168 has its own individual On/Off switch. Individually switch each clock "Off" when its second hand is at 15 seconds past the minute. This starting position assures more reliable motor startup. After all clocks are set, turn off the impulse driver output, then individually turn on each ES-168. Now, when real time reaches 15 seconds past the minute, the impulse driver output can be turned "On", starting all clocks in unison. The minutes and hours on each ES-168 are set with the knob on the rear of the clock movement. The ES-165 can be synchronized from an external source, such as a 1 PPS output or an impulse driver output of an ES-160, ES-190 or other similar master clock. A rear mounted 9-pin connector is provided for this purpose. An impulse driver output would be connected to pins "1" and "2" on this connector. A 1 PPS, 5 volt logic type signal would connect between pins "4" (input) and pin "9" (ground). The ES-168 clocks connect to the terminal block on the rear; polarity is not important.

### SPECIFICATIONS

Power required: 117 VAC, 60 Hz, 2 watts max.

Synchronizing Inputs: Pins 1 & 2, 10 to 24 volt alternating polarity  
Pins 4 & 9, 2-25 Vpp logic pulses (250  $\mu$ sec minimum)

Output: 3 Vpp, 8 Hz

Mechanical: 1 3/4" x 19" panel, chassis 10" deep

CIRCUIT DESCRIPTION: The ES-165 provides an 8 Hz, 3 volt peak to peak square wave output to drive ES-168 impulse clocks. A crystal oscillator composed of crystal X1 and part of Z2 produces 1.966080 MHz, which is divided by a factor of two by half of flip-flop Z5. The resulting 0.98 MHz signal is then divided down to 3840 Hz by IC Z3, then divided down to 16 Hz by IC Z4, then finally divided by two again by the other half of Z5. Pins 15 and 14 of Z5 provide 8 Hz signals in a positive and negative phase. IC Z6 buffers these signals, which then drive transistors Q3-Q6, the bridge-type output amplifier. Q2 regulates the 6.8V supply down to 1.5V for the output stage. The output stage should then output twice this value, or 3 Vpp. This is the optimum value for driving the ES-168. Synchronizing the ES-165 to an external reference is accomplished by resetting part of the frequency divider chain momentarily at each transition of the input reference (usually every 1 or 2 seconds, depending upon the source). Opto-isolator Z7 functions as an interface to accommodate various types of inputs. AC impulse driver signals are applied to the LED portion of Z7. Logic signals are applied to the transistor portion of Z7. The signal is then filtered, squared up, and applied to a pulse generator formed by part of Z2. A 1 microsecond pulse is thus produced, which resets Z3, Z4 and part of Z5, correcting any accumulated error. With no external input, the unit will free-run off of its crystal oscillator. This ability, along with the battery backup, will allow operation during power failures. The battery is float charged from the 6.8 volt power supply. D1, D2, C1 and C2 form a full-wave doubler which provides from 12-16 VDC. This is regulated down to 6.8 volts by IC Z1 and transistor Q1. The output On/Off switch disables the 4 buffers in Z6 used in the output stage. This removes the drive to the output transistors.

WARNING--This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

QTY	DESIGNATION	DESCRIPTION	PART NUMBER
1	Z7	INTEGRATED CIRCUIT	IL-5 OR 4N37
1	Z1	INTEGRATED CIRCUIT	741
2	Z2;Z8	INTEGRATED CIRCUIT	4001
1	Z3	INTEGRATED CIRCUIT	4020
1	Z5	INTEGRATED CIRCUIT	4027
1	Z6	INTEGRATED CIRCUIT	4503
1	Z4	INTEGRATED CIRCUIT	4520
3	Q2;Q3;Q6	TRANSISTOR	PN2222
2	Q4;Q5	TRANSISTOR	2N2907
1	Q1	TRANSISTOR	2N3055
8	D4-D11	DIODE	1N914 OR 1N4148
2	D1;D2	DIODE	1N4003
1	D3	DIODE	PN5235
1	C6	CERAMIC CAPACITOR	25 pf 50v
3	C4;C7;C11	CERAMIC CAPACITOR	68 pf 50v
2	C8;C9	CERAMIC CAPACITOR	.01 uf 50v
1	C10	ELECTROLYTIC CAPACITOR	1 uf 25v
1	C3	ELECTROLYTIC CAPACITOR	10 uf 25v
2	C1;C2	ELECTROLYTIC CAPACITOR	1000 uf 10v
1	C5	TRIMMER CAPACITOR	4-34 pf
2	R16;R17	RESISTOR	220 OHM 10% 1/4W
2	R1;R11	RESISTOR	330 OHM 10% 1/4W
4	R4;R15;R18;R19	RESISTOR	1K OHM 10% 1/4W
1	R9	RESISTOR	1.2K OHM 10% 1/2W
1	R2	RESISTOR	5.1K OHM 10% 1/4W
3	R5;R8;R10	RESISTOR	10K OHM 10% 1/4W
1	R7	RESISTOR	15K OHM 10% 1/4W
1	R6	RESISTOR	22K OHM 10% 1/4W
1	R13	RESISTOR	51K OHM 10% 1/4W
1	R12	RESISTOR	100K OHM 10% 1/4W
1	R14	RESISTOR	470K OHM 10% 1/4W
1	R3	RESISTOR	10 MEG OHM 10% 1/4W
1	X1	CRYSTAL	1.966080 MHZ
1		PC BOARD	ES-165

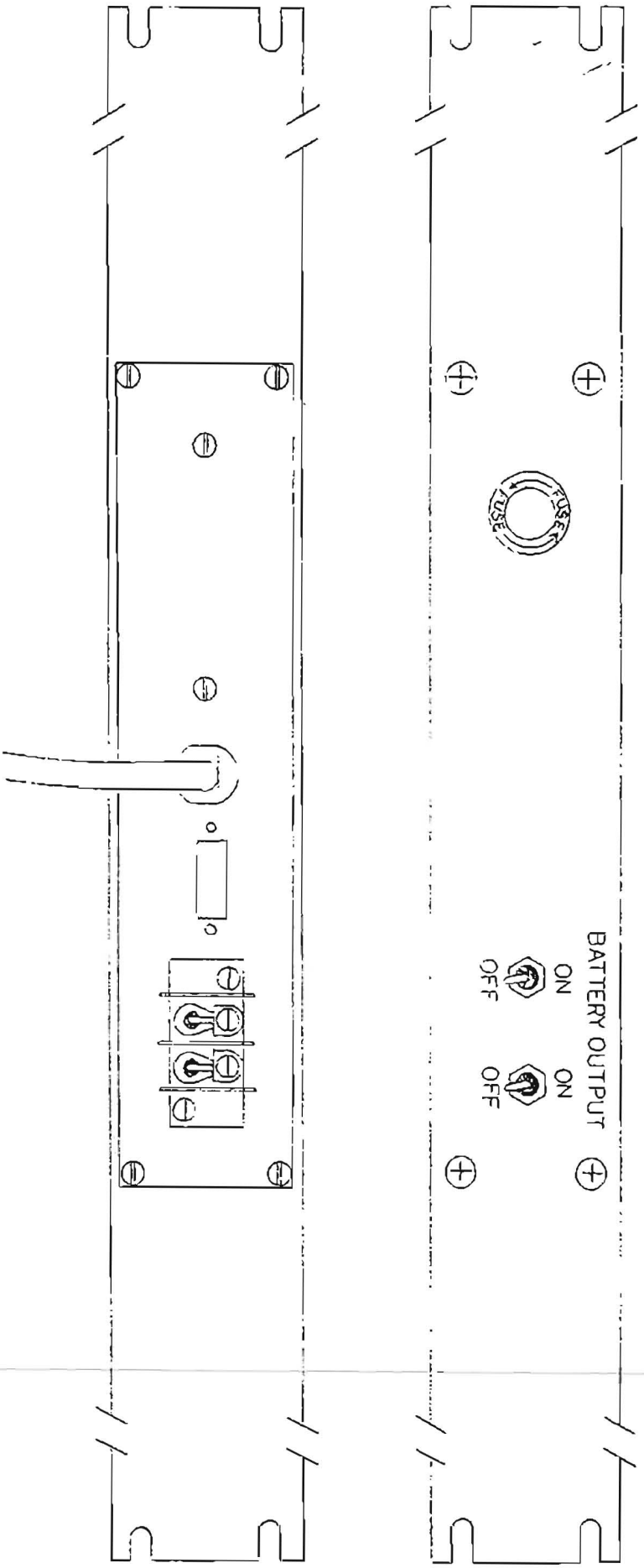
CHASSIS COMPONENTS

QTY	DESIGNATION	DESCRIPTION	PART NUMBER
1		TRANSFORMER	P6465
2	S1;S2	SWITCH	SPDT TOGGLE
1		FUSE POST	HTA
1		2 AMP FUSE	AGC 2A FB
1		FEMALE CONNECTOR	9-PIN FEMALE
1		MALE CONNECTOR	9-PIN MALE
1		CABLE CLAMP	9-PIN D-SUB HOOD
1		TERMINAL BLOCK	2-140-Y
1		CASE & HARDWARE	ES-165
1		LINE CORD	3-WIRE 6'
2		WIRE CAPS	71B
1		BATTERY (6v-1.2 AH)	NP1.2-6
1		BATTERY BRACKET	ES-165

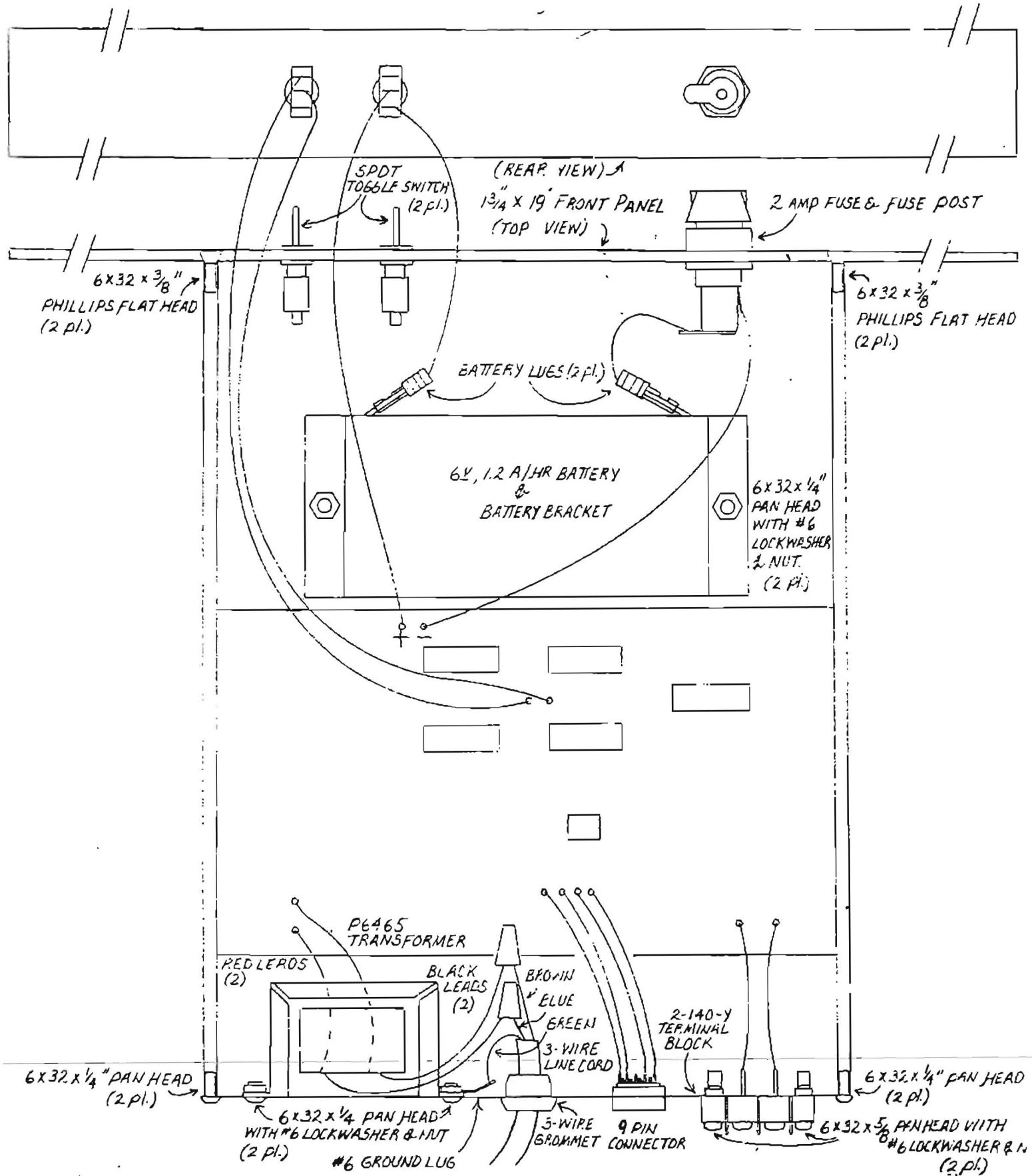
IF COMPONENT REMOVAL IS REQUIRED, WE RECOMMEND REMOVING ALL SOLDER USING A 35W OR SMALLER SOLDERING IRON AND 'SOLDER WICK' TO PREVENT DAMAGE TO THE PRINTED CIRCUIT BOARD.

ALL INFORMATION CONTAINED IN THIS MANUAL IS SUBJECT TO CHANGE WITHOUT NOTICE.

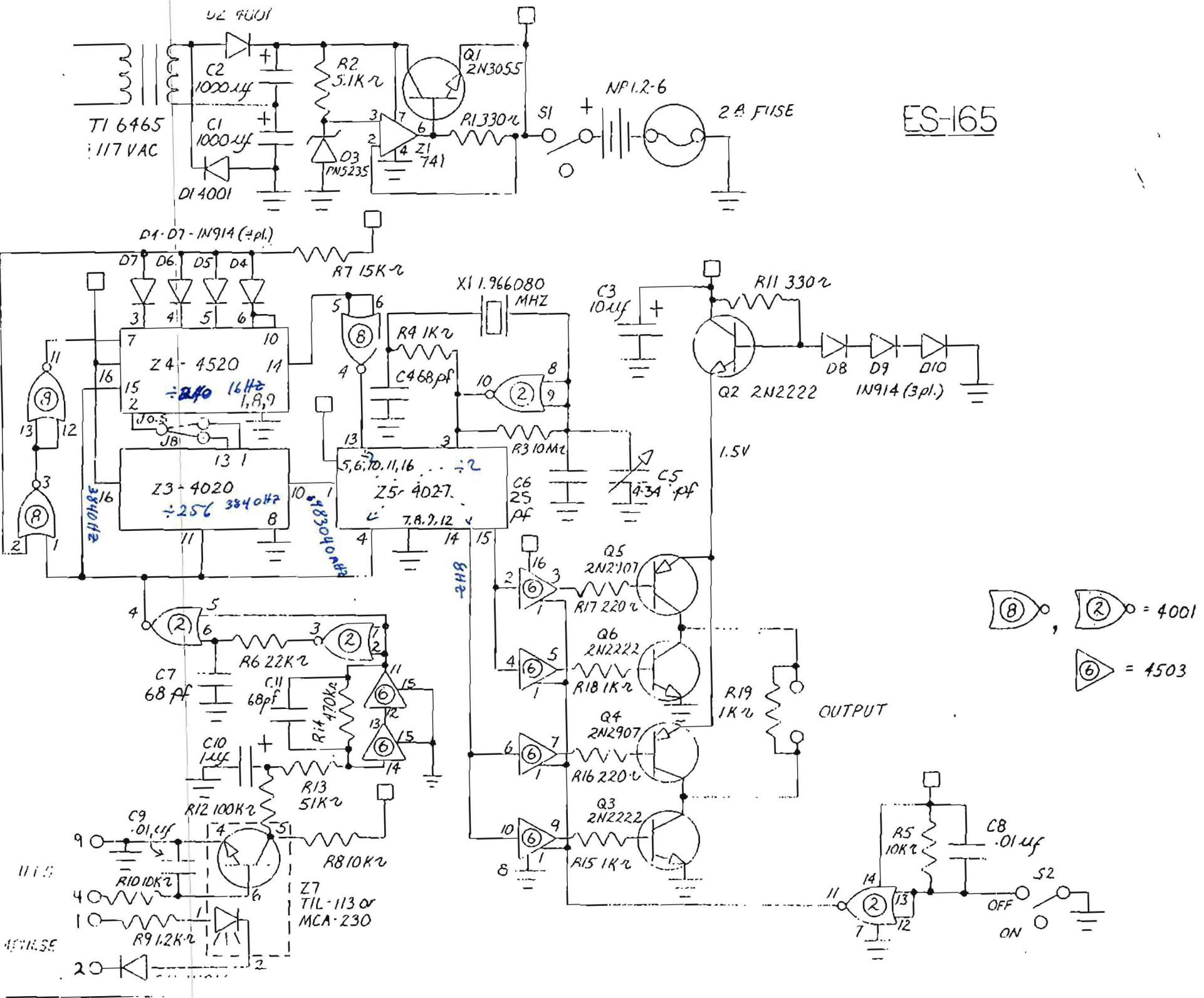
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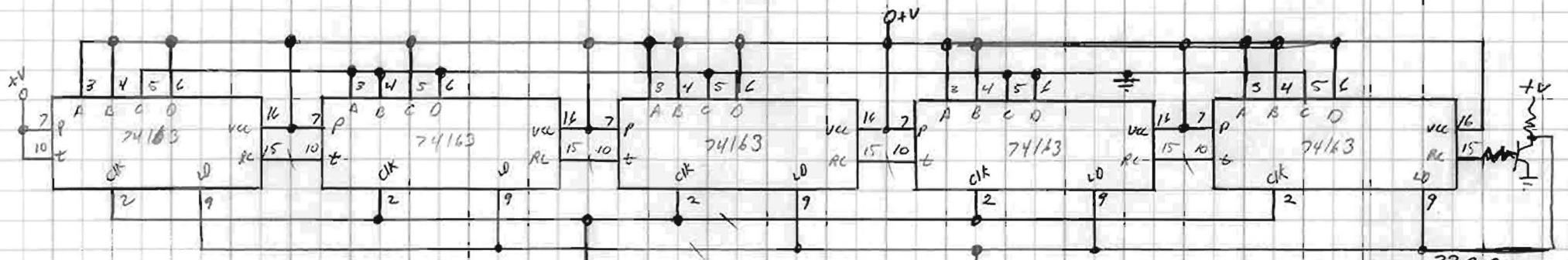


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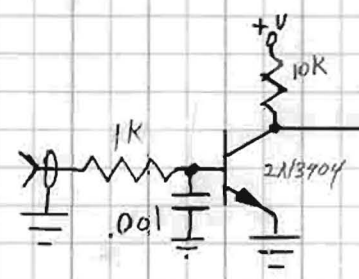




HC404  
 8384B

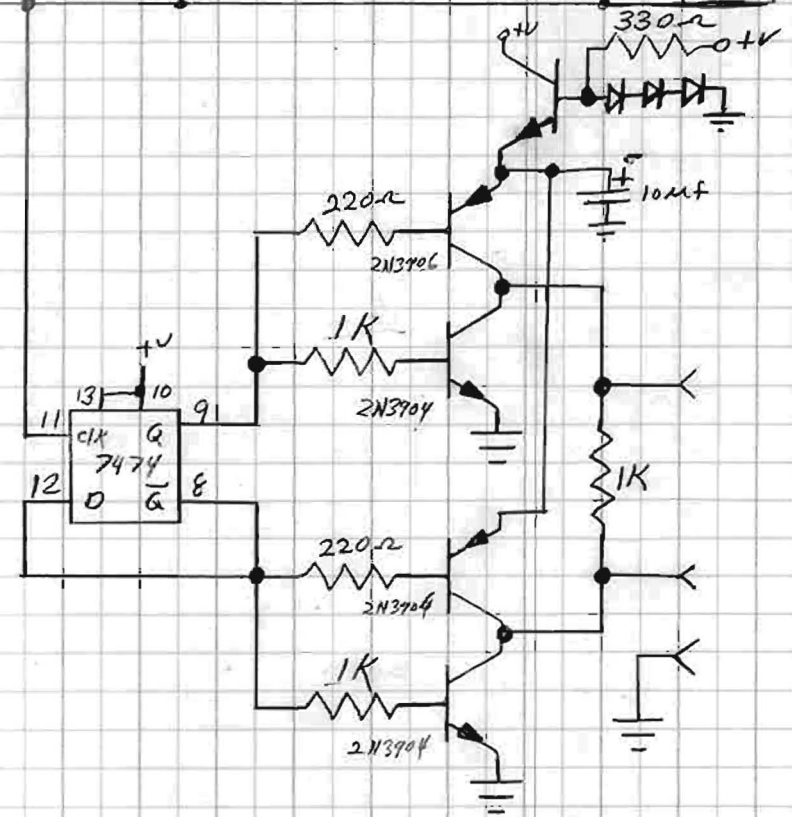


clock input



Original replaced with  
 this circuit by Garth  
 Steck

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+V pin 15 74163  
 pin 14 7474  
 GND pin 8 74163  
 pin 7 7474