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Operation and Maintenance Manual

-ES 510-

## Operating Instructions

The ES 510 is a four digit sixty minute timer with three front mounted controls (start, stop and reset). Each of the controls is actuated by pressing the appropriate switch. The timer will run continuously unless stopped. If stopped the timer will hold the time displayed when it was stopped. Pressing the start switch will initiate timing from the time on the display. The reset control returns the display to 00:00. The timer may be reset while it is stopped or while it is running. If it is reset while running it will reset to 00:00 and continue to run. When power is first applied the display may come on in strange looking characters. It is recommended that after first application of power or after power loss the timer be reset to clear all counters and begin normal operation.

## Specifications

Mechanical - Etched Aluminum case 2 3/4" High x 6" Wide x 5 5/8" Deep
Electrical - Input Voltage - 117V AC 60 Hz; Power requirement - 10W maximum

## Circuit Description

The ES 510 can be divided into four sections: power supply and clock, control, counting and display. Each section will be discussed below.

### Power Supply and Clock

The power supply consists of T1, D1 thru D4, R3 and C1. D1 thru D4 form a full wave bridge rectifier for the 6.3V transformer T1 while R3 and C1 form a filter to reduce ripple. The supply is not regulated since it is not required for proper timer operation. Typically the voltage (Vcc) at the positive terminal of C1 will be 5.25V DC with .5 VPP of ripple when the display is at 00:00. The clock consists of R1, R2 and C2. They form a filtered 60 Hz clock (approximately a sinusoid) which is typically 4 VPP (0 to +4V). D5 is used to reduce the Vcc supply to the displays to approximately 4.5V.

### Control

The start and stop controls work using a latch to either reset or allow counter Z11 to count. Z10 forms the latch with R5, C4 and R7, C5 acting as filtered pull-ups to Vcc for the start (S1) and stop (S2) switches. If S1 is pressed momentarily then pins 6 and 7 of Z11 should go to approximately OV (.8V max). If S2 is pushed momentarily then pins 6 and 7 of Z11 should go to approximately +4V (2.4V minimum).

The reset control works by momentarily resetting counters Z5, Z6, Z7, Z8 and Z12. When the reset switch (S3) is pressed and held the voltage at pins 2 and 3 of counters Z5, Z7 and Z12 should be at approximately +4V (2.4V minimum). The voltage at pins 4 and 10 of Z9 should be at approximately OV (.8V max) and the voltage at pins 6 and 7 of counters Z6 and Z8 should be at approximately +4V (2.4V minimum). When S3 is released the voltage at pins 2 and 3 of Z5, Z7 and Z12 and the voltage at pins 6 and 7 of Z6 and Z8 should go to approximately OV (.8V max) and the voltage at pins 4 and 10 of Z9 should go to approximately +4V (2.4V minimum) R6 and C3 act as a filtered pull-up to Vcc for the reset switch.

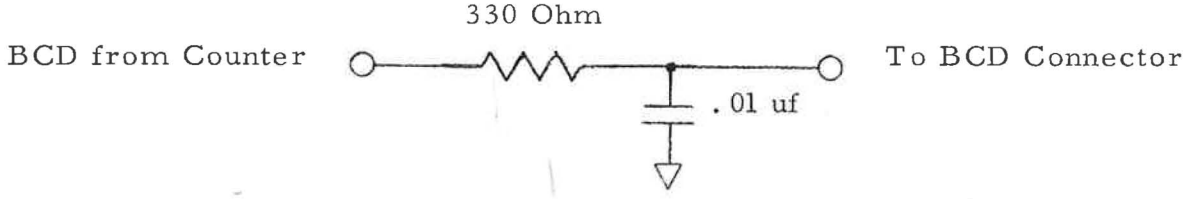
## Counting

Counting is achieved by dividing the 60 Hz clock properly using counters Z5, Z6, Z7, Z8, Z11 and Z12. Z11 receives the 60 Hz clock at pin 14, divides it by 6 producing a 10 Hz clock, typically 4 VPP (0 to +4V) at pin 8. Z12 receives the 10 Hz clock at pin 14 and divides it by 10 producing a 1 Hz clock at pin 8. Z5 receives the 1 Hz clock at pin 14 and divides it by 10 producing a clock or more easily described a +4V to OV transition once every ten seconds at pin 11. Z6 receives this transition at pin 14 and divides by 6 so that Z6 produces a +4V to OV transition once every 60 seconds at pin 9. Z6 is caused to divide by 6 by feeding an output (pin 8) back through two gates of Z9 which cause Z6 to reset to zero after it has counted five transitions from Z5. Z7 receives the transition from Z6 once every 60 seconds at pin 14 and divides by 10 so that Z7 produces a +4V to OV transition once every 10 minutes at pin 11. Z8 receives this transition at pin 14 and divides by 6. Z8 is caused to divide by 6 by feeding an output (pin 8) back through two gates of Z9 which cause Z8 to reset to zero after it has counted 5 transitions from Z7.

## Display

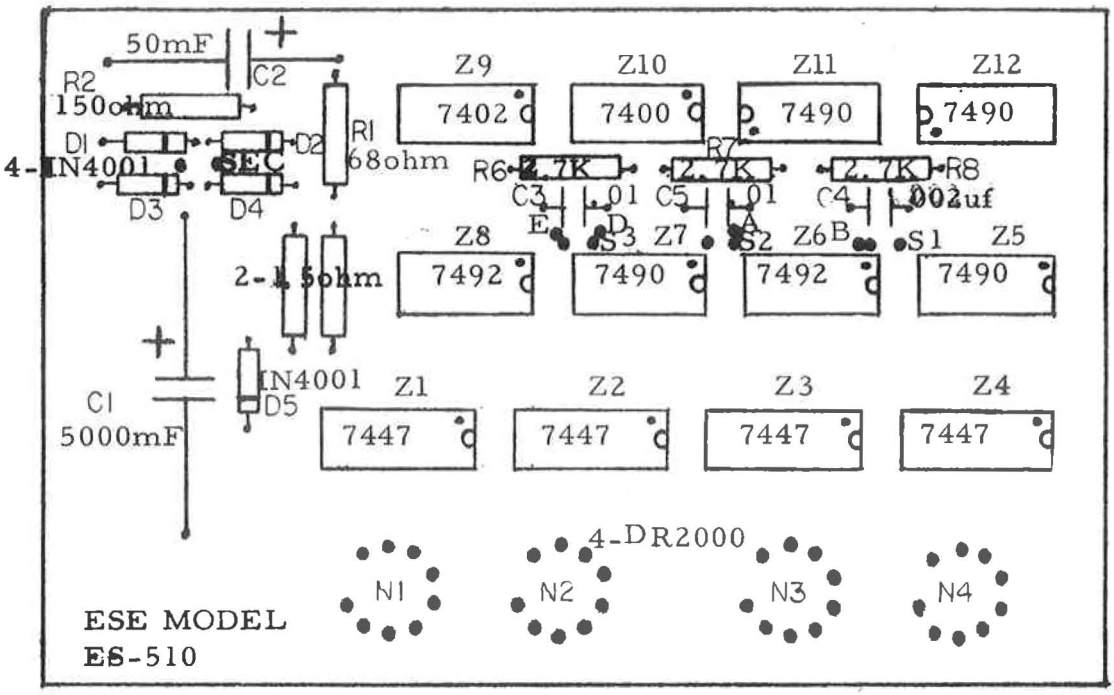
The visual display is achieved by decoder drivers Z1 - Z4 and displays N1 - N4. Z1 thru Z4 are BCD to seven segment decoders which take the BCD information from the counters Z5 thru Z8 and transform it into seven segment format. A decoder applies OV (.8V max) to the appropriate filaments of the display giving a numeric display. The display has seven filaments, one end of each tied in common (pin 2 of each display) with the other end of each connected to the decoder. The common is connected through D5 to Vcc so that when a decoder output goes to OV the filament will have voltage across it causing it to light. Following is a table showing the proper display for all possible BCD inputs to a decoder.

When BCD output is supplied we add an RC filter to each output as shown below. This is done to slow down output information in order to minimize transient problems when driving long lines. This has the limitation however, that only two standard TTL loads may be driven from any BCD output. If required, more loads could be driven by using a smaller resistance.



## Printed Circuit Board Layout

(Letters A, B, D and E correspond to connections to remote connector)

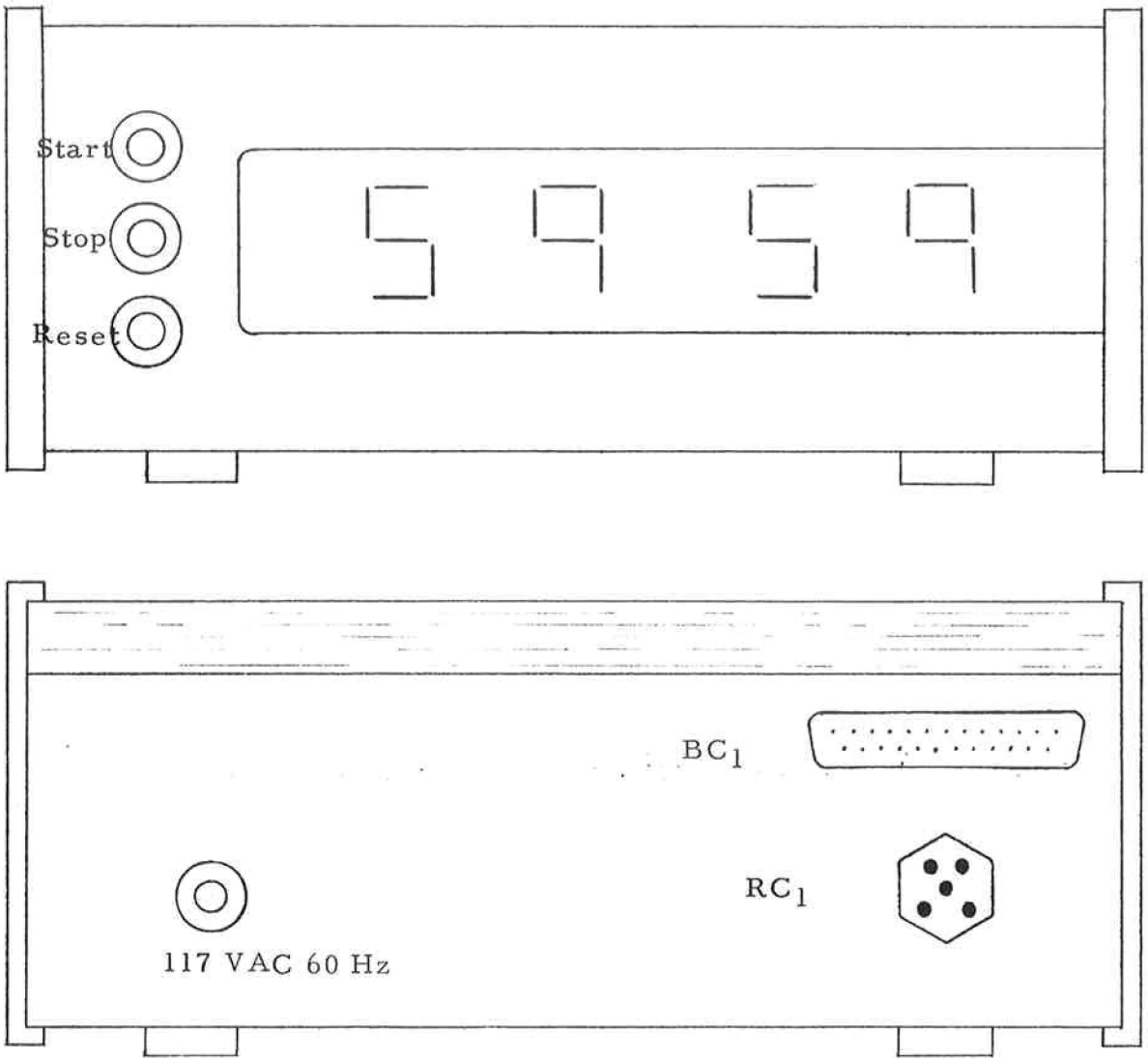



## Truth Table

BCD Inputs to Decoder

"1" = 2.4V Min "0" = .8V Max

| A | B | C | D | Display |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 |
| 0 | 1 | 0 | 0 | 2 |
| 1 | 1 | 0 | 0 | 3 |
| 0 | 0 | 1 | 0 | 4 |
| 1 | 0 | 1 | 0 | 5 |
| 0 | 1 | 1 | 0 | 6 |
| 1 | 1 | 1 | 0 | 7 |
| 0 | 0 | 0 | 1 | 8 |
| 1 | 0 | 0 | 1 | 9 |
| 0 | 1 | 0 | 1 | |
| 1 | 1 | 0 | 1 | |
| 0 | 0 | 1 | 1 | |
| 1 | 0 | 1 | 1 | |
| 0 | 1 | 1 | 1 | |
| 1 | 1 | 1 | 1 | Blank |




## Connector Designations

### Connector RC1

| Pin | Function | |
|---|---|---|
| A | Stop | Momentary Short to Ground |
| B | Start | |
| D | Reset | |
| E | Ground | |

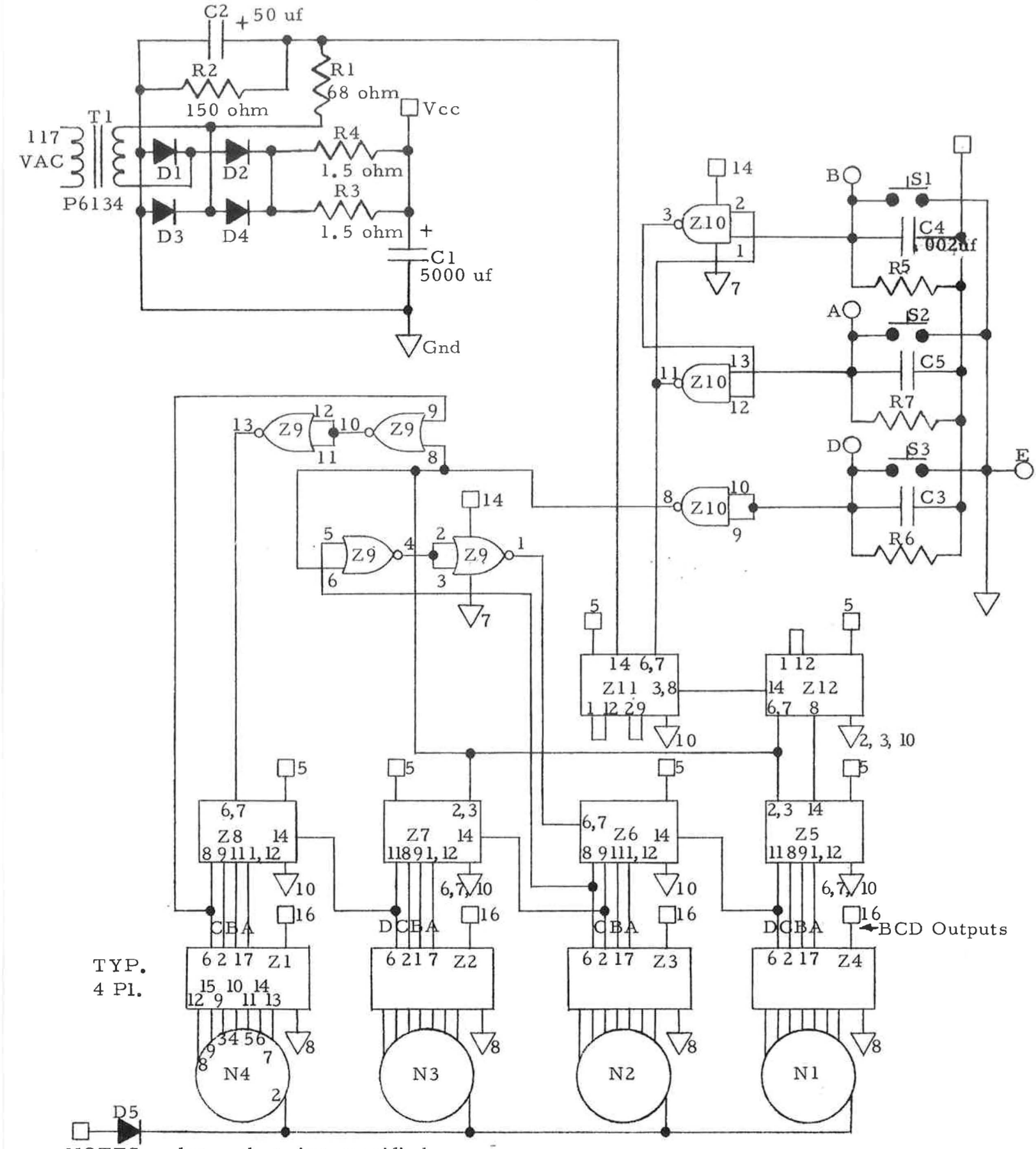
(RC1 supplied for Remote only, BC1 supplied for BCD or BCD and Remote).

When 10ths of seconds is supplied, Pin 20 is A, Pin 21 is B, Pin 22 is C, and Pin 24 is D.

### Connector BC1

| Pin | Function | |
|---|---|---|
| 1 | A1 | Outputs from Standard TTL counters |
| 2 | B1 | |
| 3 | C1 | |
| 4 | D1 | |
| 5 | A2 | |
| 6 | B2 | |
| 7 | C2 | |
| 9 | A3 | |
| 10 | B3 | |
| 11 | C3 | |
| 12 | D3 | |
| 13 | A4 | |
| 14 | B4 | |
| 15 | C4 | |
| 17 | Start | Momentary Short to Ground |
| 18 | Stop | |
| 19 | Reset | |
| 24 | Ground | |
| 8, 16, 20-23, 25 | Not Used | |

# SCHEMATIC
# ES 510




NOTES: unless otherwise specified.

1. Resistors are 2.7Kohm.
2. Capacitors are .01 uf.
3. Diodes are 1N4001.
4. Z1 - Z4 are 7447's.
5. Z5, Z7, Z11, Z12 are 7490's.
6. Z6, Z8 are 7492's.
7. Z9 is a 7402.
8. Z10 is a 7400.
9. N1 - N4 are DR2000.

# PARTS LIST

## ES 510

| Qty | Designation | Description | P/N |
|---|---|---|---|
| 4 | Z1 - Z4 | IC | 7447 |
| 4 | Z5, Z7, Z11, Z12 | IC | 7490 |
| 2 | Z6, Z8 | IC | 7492 |
| 1 | Z9 | IC | 7402 |
| 1 | Z10 | IC | 7400 |
| 5 | D1 - D5 | Diodes | 1N4001 or 1N3611 |
| 1 | R1 | Resistor | 68 Ohm 1/2W ± 10% |
| 1 | R2 | Resistor | 150 Ohm 1/2W ± 10% |
| 2 | R3, R4 | Resistor | 1.5 Ohm 1/2W ± 10% |
| 3 | R5 - R7 | Resistor | 2.7 Kohm 1/2W ± 10% |
| 1 | C1 | Capacitor | 4700 uf min 6V min |
| 1 | C2 | Capacitor | 47 or 50 uf 6V min |
| 2 | C3, C5 | Capacitor | .01 uf ± 20% 10V min |
| 1 | C4 | Capacitor | .002uf ± 20% 10V min |
| 4 | N1, N2, N3, N4 | Display | DR 2000 or DA 1300 |
| 3 | S1, S2, S3 | Momentary Switch | #44 Cream |
| 1 | T1 | Transformer | P-6134 |
| 1 | | PCB | ES 510 |
| 1 | | Line Cord | 2 Wire 7' |
| 2 | | Wire Caps | 71B |
| 1 | | Case | 10001 |
| 1 | | Case Hardware | |

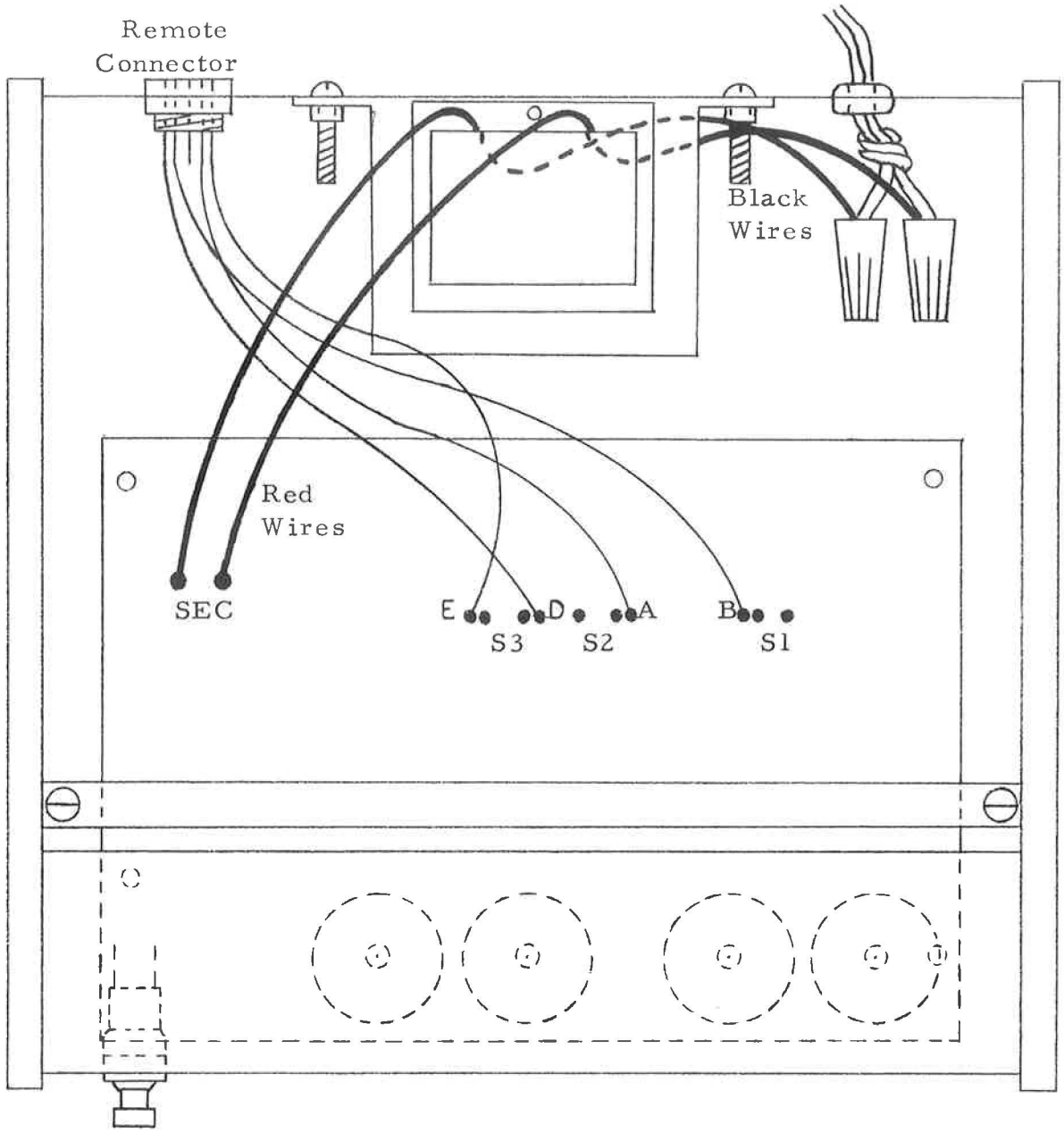
## OPTIONAL PARTS

| | | | |
|---|---|---|---|
| 1 | | Male Remote Connector | 126-010 |
| 1 | RC1 | Female Remote Connector | 126-011 |
| 1 | | Remote Cable Clamp | 126-1063 |
| 1 | | Male BCD Connector | 17-20250 |
| 1 | BC1 | Female BCD Connector | 17-10250 |
| 1 | | BCD Cable Clamp | 17-312-01 |

If component removal is required it is recommended that it be done by removal of all solder using a 35 W 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.

NOTE: If you ordered this unit in kit form, be sure to solder both leads of C1 on the top and bottom sides of the printed circuit board. Also, solder those pins of all IC's which have conductors or pads on the top side, as well as all connections on the bottom side.




Disassembly Instructions

1. Remove walnut grained cover held by two screws in rear.

2. Remove metal strap held by one screw in each side panel.

3. Remove the two side panels, each held by two screws, one on rear and one on the bottom.

4. Remove switches from front.

5. Remove transformer T1.

6. Remove board from chassis by compressing split end of standoffs (on bottom of chassis) and pressing upward to release from chassis.