Large 4-Digit led digital clock

Students will be assembling a 4-Digit LED Digital clock.
This project combines the assembly of printed circuit boards,
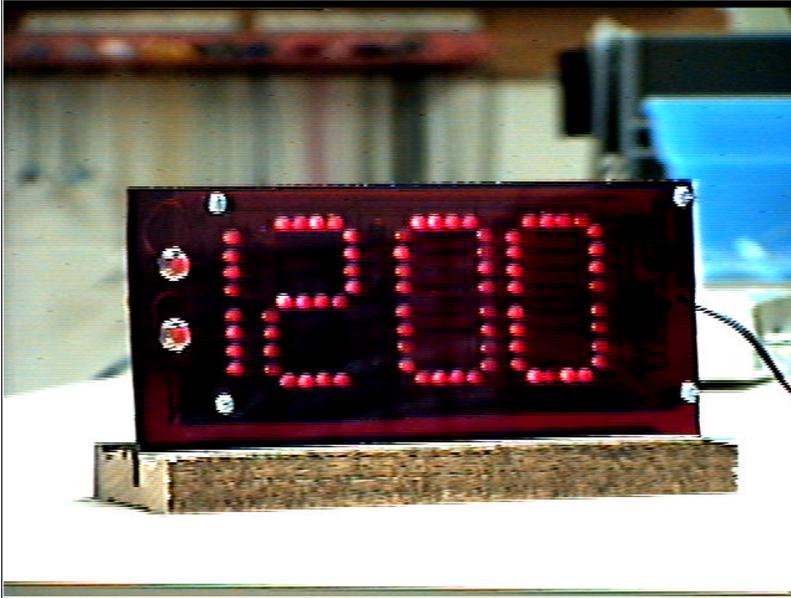***point-to-point wiring and wire wrapping.***

Fig 1   Front View of completed clock

The Large 4-digit clock is fabricated in an open frame package and, in normal use is displayed on a grooved wooden pedestal. (Fig 1, & FIG 2).

This project combines three electronic wiring topologies: (1) soldering on a printed circuit board (pcb) (2) wire wrapping, (3) soldering with joint to point wiring techniques.

This project also exemplifies common modular assembly of electronic components assemblies using standoff spacers and a multi-board assembly of the clock system.
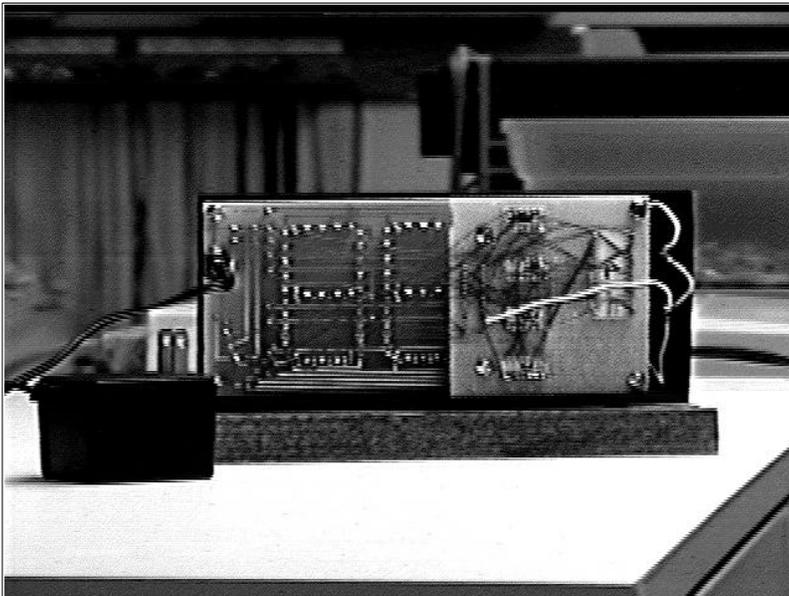
The clock's electronic circuit is based on the MOSTEK® MOS digital alarm clock I.C. the MK 50250. This fully capable digital alarm clock I.C. can drive 6-digital displays for hours minutes and seconds, 24 hour alarm function and snooze alarm.   In this EE 151 implementation the minimum features of a clock were selected. Students may explore adding options on their own and at a latter date.

Fig 2   Back View of completed clock

The clock is powered by a12 volt AC wall mount transformer which plugs into the clock via a 5.0mm power plug. Time keeping accuracy is achieved by utilizing the 60 hz power frequency, which is maintained by the power utility to plus / minus 5%. A multiplexed 4-digit display has been designed with 96 discrete light emitting diodes.

part 1 assembly of the display

Component side of display board.   Traces appear as if the board is transparent.

Power Supply Components

15 wire wrap pins

11 bare wire jumpers

LED's shown partially installed.
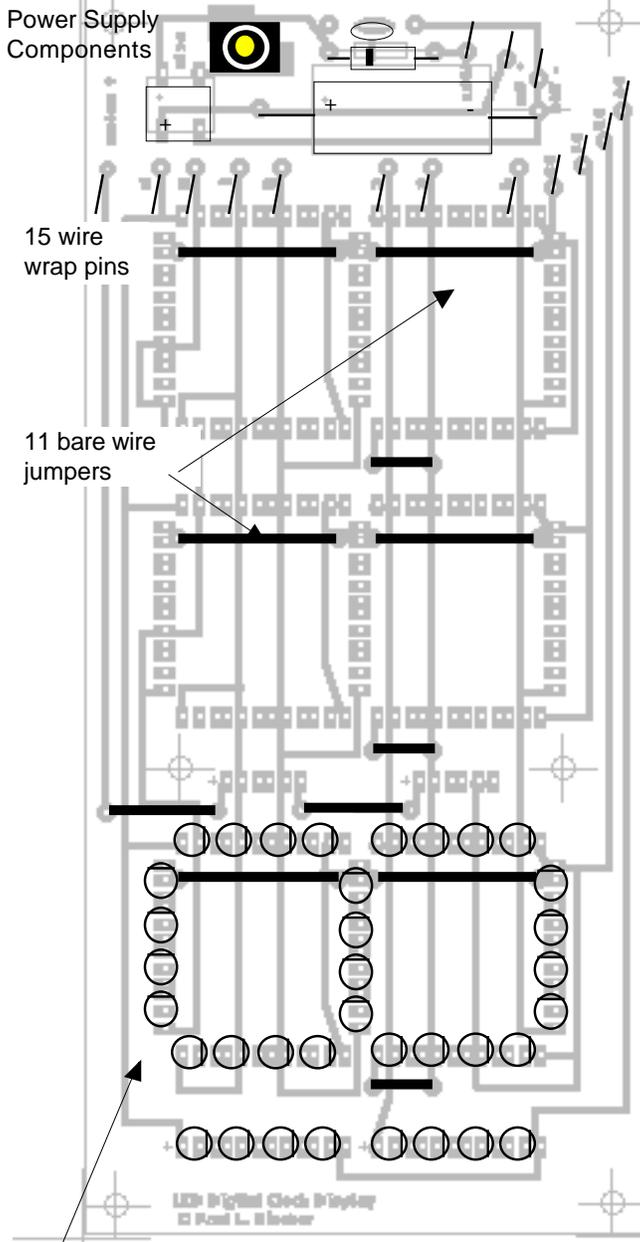
Fig 3

Preliminary: Locate the 3" x 7" printed circuit board (FIG 3) and identify the display components from the DISPLAY COMPONENTS PARTS LIST.

1.   Install 11 bare wire jumpers making certain they are straight, and flat against the component side of the printed circuit board.

2.   Install 96 light emitting diodes forming the digital display. Make certain the diodes are correctly oriented for polarity and are pushed completely into the pc board. Make certain that the LED's are straight and symmetrical.

3.   Install 15 wire wrap pins on the Right side of the printed circuit board. The wire wrap pins are inserted from the component side of the board, and long pins extend beyond the foil traces on the wiring or soldering side of the printed circuit board. When soldering make certain that the pins are not contaminated with solder other than the parts where they contact the printed circuit board.
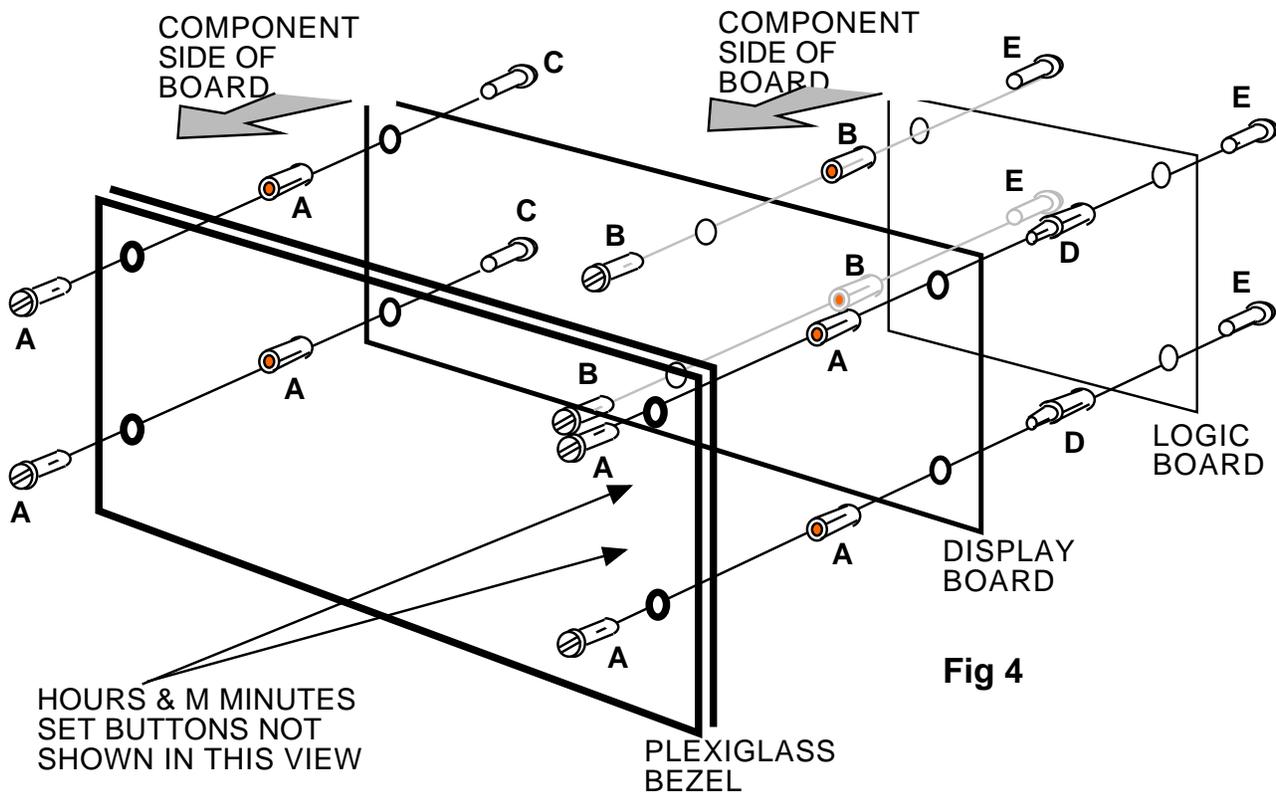
4.   Install the Power Supply components at the right side of the display.   This consists of the rectifier assembly, filter capacitor, and the 60hz diode and capacitor waveform shaping components.

5.   Install the 5.0mm x 2.1mm power connector on the foil side of the printed circuit board.   The installation of this part is unique, as it will be installed in a surface mount arrangement on the foil side of the printed circuit board. The soldering of this part is critical because the solder provides both electrical connection and mechanical support

part 2 mechanical assembly of clock

COMPONENT SIDE OF BOARD

COMPONENT SIDE OF BOARD

C

E

E

B

E

O

A

C

B

E

O

D

A

O

B

O

E

A

B

A

A

O

D

A

LOGIC BOARD

O

DISPLAY BOARD

A

Fig 4

O

A

HOURS & M MINUTES SET BUTTONS NOT SHOWN IN THIS VIEW

PLEXIGLASS BEZEL

Note: The assembly of mechanical parts as illustrated sequences the parts in their <u>upside down</u> orientation FIG 4.

Preliminary: Locate the Plexiglass front panel assembly and carefully remove the protective film from the front and rear. The <u>front</u> of the panel can be identified by holding the panel so that the hours and minutes push button are on the left side.   Install the red push button switches in the pre-drilled holes but do not attach any wires to the connections.   Note that in the above referenced mechanical assembly drawing that the bezel and electronic boards are shown upside down for clarity.

Hardware designation - A.   Attach 4 each .50" x 6x32 threaded spacers to the rear of the panel using 4 each 1/4" 6-32 pan head screws.

Hardware designation -B. After completion and testing of the display and power supply assembly attach 2-each .5" x 6-32 threaded spacers to the center of the board, foil or wiring side and secure them with 2-each .25" 6-32 pan head screws from the component (LED) side.

Hardware designation -C Attach one side of the display board to the bezel with 2-each .25" 6-32 screws.

Hardware designation -D. Attach two special male/female .50" threaded spacers into the display board, threading them into the spacers already mounted on the bezel. This completes the attachment of the display to the bezel.

Hardware designation -E. The remainder of the hardware, 4-each .25" 6-32 screws are used to attach the logic board to the back of the display board. <u>This can be done before wire wrapping, as the assembly helps hold the wire wrap board during the wiring process.</u>

part 3 Wire wrapping of the logic board

1.   The wire wrap logic board assembly can be attached with mounting hardware <u>before any wire wrapping commences</u> (FIG 5)

2. Below is a diagram of the component locations.

3. Wire lists on P6 and P7 are used to complete the wiring.

4. The special wire harness allow the hours and minutes set switches to be wired and plugged into the logic board.
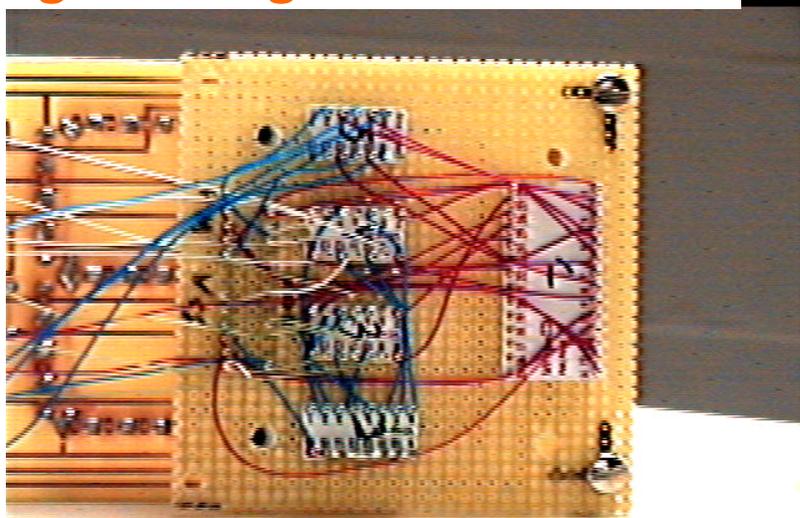

Fig 5

SPECIAL CABLE HARNESS. ATTACHES SWITCHES TO LOGIC BOARD.   ONE WIRE BRINGS +VCC TO EACH SWITCH. THE OTHER TWO WIRES RETURN EITHER CLOSURES OF THE HOURS OR MINUTES SWITCH.

WIRE SIDE OF PERF.. BOARD

TO HOURS AND MINUTES SET SWITCHES

IC 5

IC 4

IC 1

IC 3

+VSS

-VDD

POWER DISTRIBUTION +VSS   -VDD

IC 2

THESE PINS ARE SOLDERED TOGETHER ON THE COMPONENT SIDE OF THE BOARD. PLEASE CHECK THESE CONNECTIONS AND MAKE CERTAIN THAT THE POWER DISTRIBUTION PINS ARE ALL CONNECTED AS SHOWN.

WIRING VIEW OF HOURS / MINUTES PUSH BUTTON SWITCHES.

PARTIAL REAR VIEW OF PLEXIGLASS FRONT BEZEL.

Fig 6

4-DIGIT DIGITAL CLOCK

part 3   how to wire wrap

Fig 7

Example of a proper wire wrap connection. Note the symmetrical helix of bare wire secure to the wire wrap post.

socket shown without board

Fig 8

Example of a "two-level" wrap. Note the symmetrical helix of bare wire.

Notice the additional insulation wrapped at the base of the helix. This Modified wrap adds strength to the connection.

Fig 9

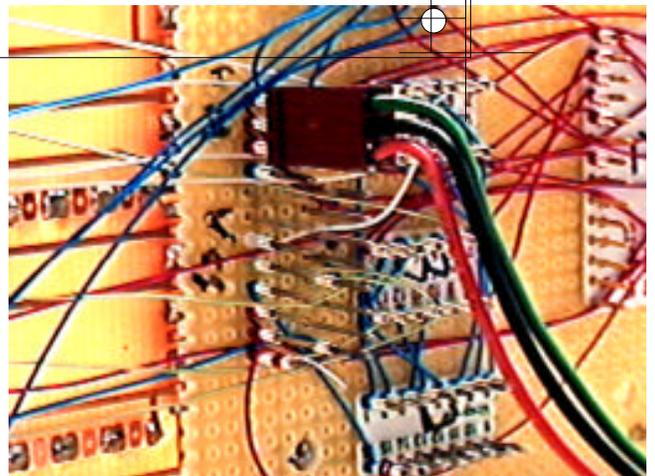Here is an example of a "bad wrap" . Notice that there is no helix of wire. The wire is all balled up on the bottom edge of the post. This connection will work but does not have the integrity of a proper wrap.
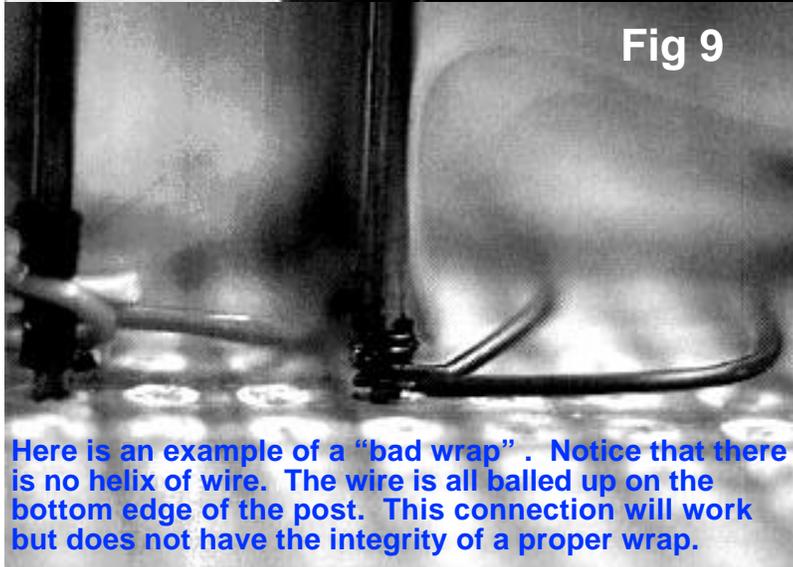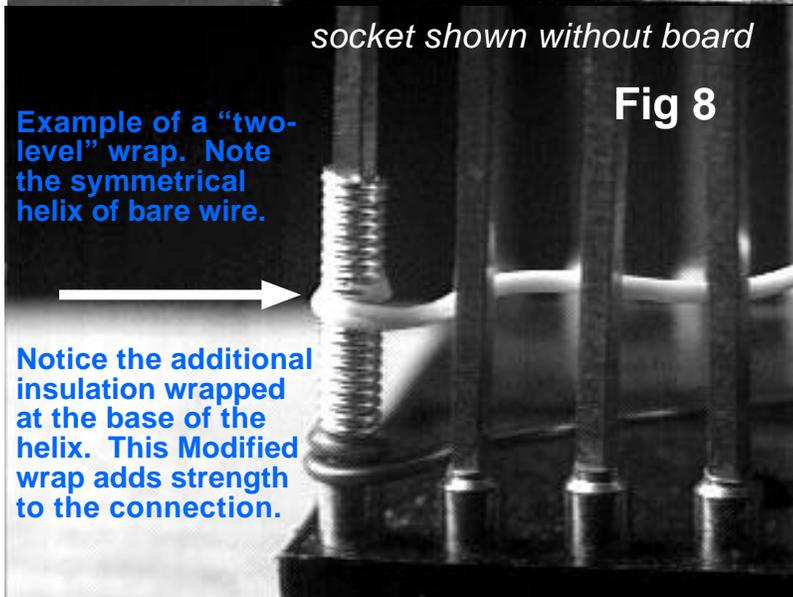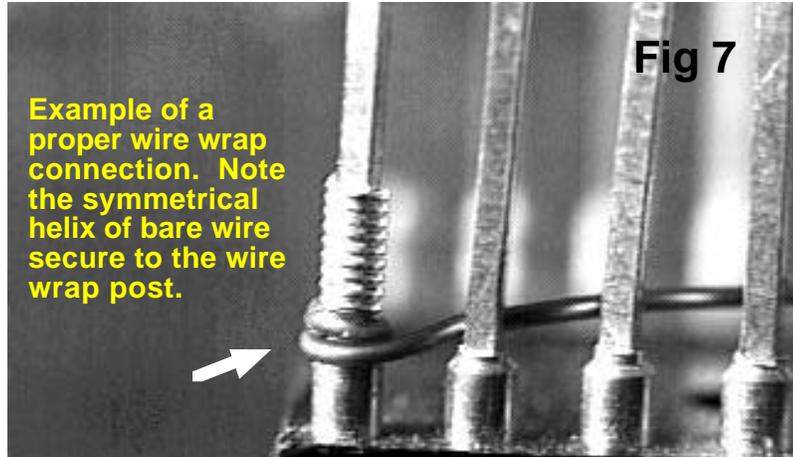
On Wire-wrapping
by Paul L. Discher

Despite its age, wire wrapping is still a popular method for making semi-permanent and permanent electronic circuits. This wiring topology is most useful for one-of a kind permanent systems or prototpying production circuits.

Wire-wrapping employs special equipment and wire for interconnecting sockets and connectors . A perforated non-conducting fiberglass or epoxy circuit board material with holes spaced on 0.100 inch centers is used to hold component sockets. The material is sometimes called "PERF." board and is available in many sizes and hole spacings. ICs manufactured in DIP or dual-inline-packages have their contacts on 0.100 inch centers and match these wire wrap sockets that are employed on the PERF. boards.

Sockets and connectors for wire wrapping are fabricated with long wire wrap pins that are 0.125 inch square. Once sockets and connectors are inserted into a board a special tool is use to wrap or unwrap 30 gauge insulated wire around the wire wrap pins.

Connections are made from one wire wrap post to another by measuring, then striping insulation from the ends of the wire, and finally using a special tool to wrap the stripped wire on a conducting pin. This process continues until a complex circuit is completed.

The freedom of wire routing makes it possible to create extremely complex wiring interconnects where there is no concern over "crisscrossing" insulated wires in order to find the shortest distance to connections. However the larger drawback in wire wraping is in fact the chaotic nature of finished circuits and the difficulty in trouble shooting.

The best method for external documentation in wire wrapping is the use of wiring list. For this project the wire list are completed on Page 6 and Page 7.

IC#1 wire list

WIRE WRAP CHECK LIST & WIRE TABLE		
IC#1 MK 50250 CMOS DIGITAL CLOCK		
wired !	pin	destination
	1	VSS (+)
	2	IC#4 PIN 1
	3	IC#4 PIN 7
	4	IC#4 PIN 14
	5	IC#5 PIN 3
	6	IC#5 PIN 5
	7	IC#5 PIN 12
	8	IC#5 PIN 10
	9	IC#4 PIN 8
	10	VSS (+)
	11	VSS (+) BRIGHTNESS
	12	VSS (+)
	13	S2 (MINUTES 10S SET)
	14	S1 (HOURS SET)

WIRE WRAP CHECK LIST & WIRE TABLE		
IC#1 MK 50250 CMOS DIGITAL CLOCK		
wired !	pin	destination
	15	*NOT USED*
	16	*NOT USED*
	17	*NOT USED*
	18	*NOT USED*
	19	*NOT USED*
	20	*NOT USED*
	21	*NOT USED*
	22	DISPLAY BOARD 60HZ
	23	
	24	IC#3 PIN 1
	25	IC#3 PIN 7
	26	IC#3 PIN 14
	27	IC#3 PIN 8
	28	VDD (-)

IC#2 wire list

WIRE WRAP CHECK LIST & WIRE TABLE		
IC#2 16 PIN RESISTOR PACK		
wired !	pin	destination
	1	IC#3 PIN 3
	2	IC#3 PIN 5
	3	IC#3 PIN 10
	4	IC#3 PIN 12
	5	IC#4 PIN 3
	6	IC#4 PIN 5
	7	IC#4 PIN 10
	8	IC#4 PIN 12
	9	VSS (+)
	10	VSS (+)
	11	VSS (+)
	12	VSS (+)
	13	VSS (+)
	14	VSS (+)
	15	VSS (+)
	16	VSS (+)

IC#3 wire list

WIRE WRAP CHECK LIST & WIRE TABLE		
IC#3 14 PIN 75491 QUAD SEGMENT DRIVER		
wired !	pin	destination
	1	IC#1 PIN24
	2	DISPLAY BOARD PIN (a)
	3	IC#2 PIN 1
	4	VDD (-)
	5	IC#2 PIN 2
	6	DISPLAY BOARD PIN (b)
	7	IC#1 PIN 25
	8	IC#1 PIN 27
	9	DISPLAY BOARD PIN (d)
	10	IC#2 PIN 3
	11	VSS (+)
	12	IC#2 PIN 4
	13	DISPLAY BOARD PIN (c)
	14	IC#1 PIN 26

IC#4 wire list

WIRE WRAP CHECK LIST & WIRE TABLE		
IC#4 14 PIN 75491 QUAD SEGMENT DRIVER		
wired !	pin	destination
	1	IC#1 PIN 2
	2	DISPLAY BOARD PIN (e)
	3	IC#2 PIN 5
	4	VDD (-)
	5	IC#2 PIN 6
	6	DISPLAY BOARD PIN (f)
	7	IC#1 PIN 3
	8	IC#1 PIN 9
	9	DISPLAY + COLON
	10	IC#2 PIN 7
	11	VSS (+)
	12	IC#2 PIN 8
	13	DISPLAY BOARD PIN (g)
	14	IC#1 PIN 4

IC#5 wire list

WIRE WRAP CHECK LIST & WIRE TABLE		
IC#5 14 PIN 75492 HEX DIGIT DRIVER		
wired !	pin	destination
	1	
	2	DISPLAY BOARD PIN (D6)
	3	IC#1 PIN 5
	4	VDD (-)
	5	IC#1 PIN 6
	6	DISPLAY BOARD PIN (D5)
	7	
	8	
	9	DISPLAY BOARD PIN (D3)
	10	IC#1 PIN 8
	11	VSS (+)
	12	IC#1 PIN 7
	13	DISPLAY BOARD PIN (D4)
	14	

Display Board wire wrap - pc board transition wiring detail
partial view shown.   Fig 10