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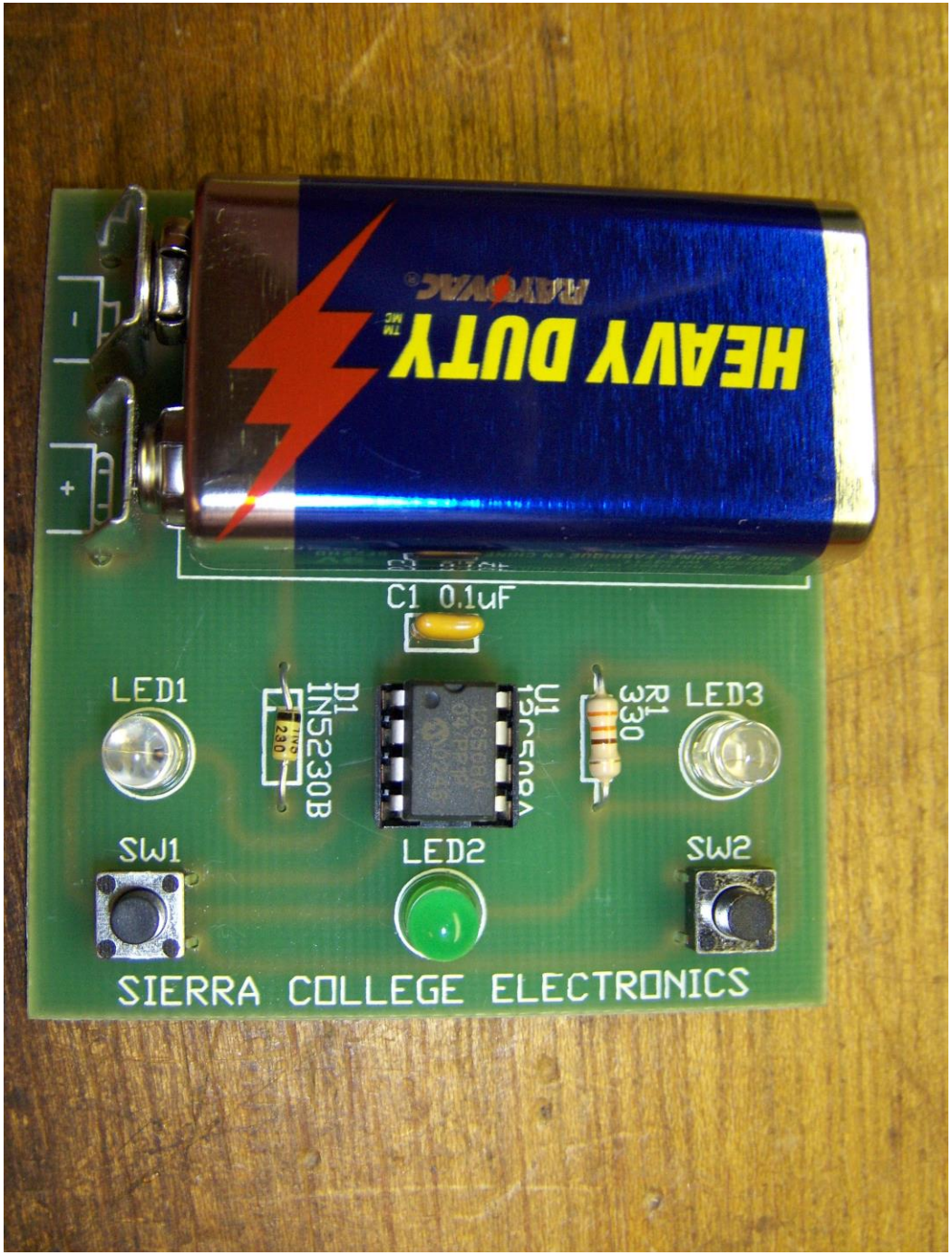
Lab 14



The Game:

There are two players, A and B. There are two pushbutton switches on the board, one for player A and one for player B. There are three lamps on the board, a red lamp for player A, a red lamp for player B, and a green "go" lamp.

Either player may start the game by pushing their switch. The other player responds by pushing their switch. After a random time between one and three seconds, the green "go" lamp lights. The first player to press their switch AFTER the green lamp lights wins. If either player presses their switch BEFORE the green "go" lamp lights they lose and the win is credited to the other player.

After seven games, the player with the most wins then wins the whole "World Series" and the lamps flash in sequence to signal the end of the Series. The player whose lamp flashes last is the winner of the Series. The game is then reset for a whole new Series.

(Note: The game does not use an on-off switch. If no button is pressed for 90 seconds, the PIC goes into a low-power "sleep" mode.)

The Theory:

The heart of the React World Series game is a Programmable Integrated Circuit microcontroller with the nickname PIC. There are hundreds of different PICs available; this one is a 12C508A. The PIC is really a miniature computer system containing all the essential elements of a computer such as a Central Processing Unit (CPU), Read Only Memory (ROM), Random Access Memory (RAM), and Input/Output ports (I/O). The advantage of using a PIC for this project is that all the required game functions are contained in one low cost device.

PICs come from the manufacturer unprogrammed. The designer must write the code that will configure and define the game's function. A common way to structure program code is with a flow chart (see the last page). After debugging the code, the PIC is programmed using a device programmer after which it can be soldered into the project. PIC program code is stored in non-volatile ROM, which means that the program is permanently stored and will not be erased when the power is turned off.

Power for the game comes from a 9 volt battery, but the PIC must operate at 5 volts. Zener diode D1 reduces the battery voltage to the proper value and capacitor C1 filters and stabilizes the voltage.

Push button switches SW1 (player A) and SW2 (player B) are connected to the PICs input ports and apply logic level 0 (zero, or ground) when pressed. Otherwise the input ports are at logic level 1 (one, or 5 volts). The program code reads the ports to detect whether a button is pressed.

LED1 (player A), LED3 (player B), and LED2 ("go") are connected to the PICs output ports. Resistor R1 sets the current through the LEDs to the proper level. The program code writes a logic level zero (off) or logic level 1 (on) to turn the LEDs on and off.

The React World Series game uses a Printed Circuit board (PC board) as the substrate, or mounting platform for the assembled circuit. PCBs are the most common assembly technique used to mass-produce electronic products. A PCB is a "sandwich" of copper bread and fiberglass filling; the copper is etched away to produce the traces or "wires" that interconnect the components.

Assembly Instructions:

Parts List		
Reference Designator	Quantity	Description
B1	1	9 volt battery
C1	1	0.1 uf ceramic capacitor
D1	1	1N5230B 4.7 volt zener diode
LED1;3	2	Light emitting diode, red, water clear case
LED2	1	Light emitting diode, green, green translucent case
R1	1	330 ohm (orange, orange, brown, gold) ¼ w 5% resistor
SW1;2	2	Pushbutton switch
U1	1	PIC 12C508A microcontroller
-	1	Printed circuit board
-	1	Positive battery clip
-	1	Negative battery clip

1. Refer to the parts list (above) and identify each part. You may wish to place the parts next to their respective line on the parts list.

2. Install the negative battery clip onto the PC board ("pcb"). Note that the negative clip has the SMALLER of the two connectors. Be sure you place it on the board in the location with the SMALL white outline, but do NOT solder it yet. Similarly, place the positive clip in the larger of the white outline location on the board. Install the battery onto the clips, press the clips firmly onto the board, and solder the battery clips to the board.

3. Remove the battery.

4. Install the two pushbutton switches SW1 and SW2 onto the pcb. The switches will snap into place when properly installed. Solder both switches to the pcb. After this step, solder all parts as they are installed.

5. Install resistor R1 onto the pcb.

6. Install capacitor C1 onto the pcb and.

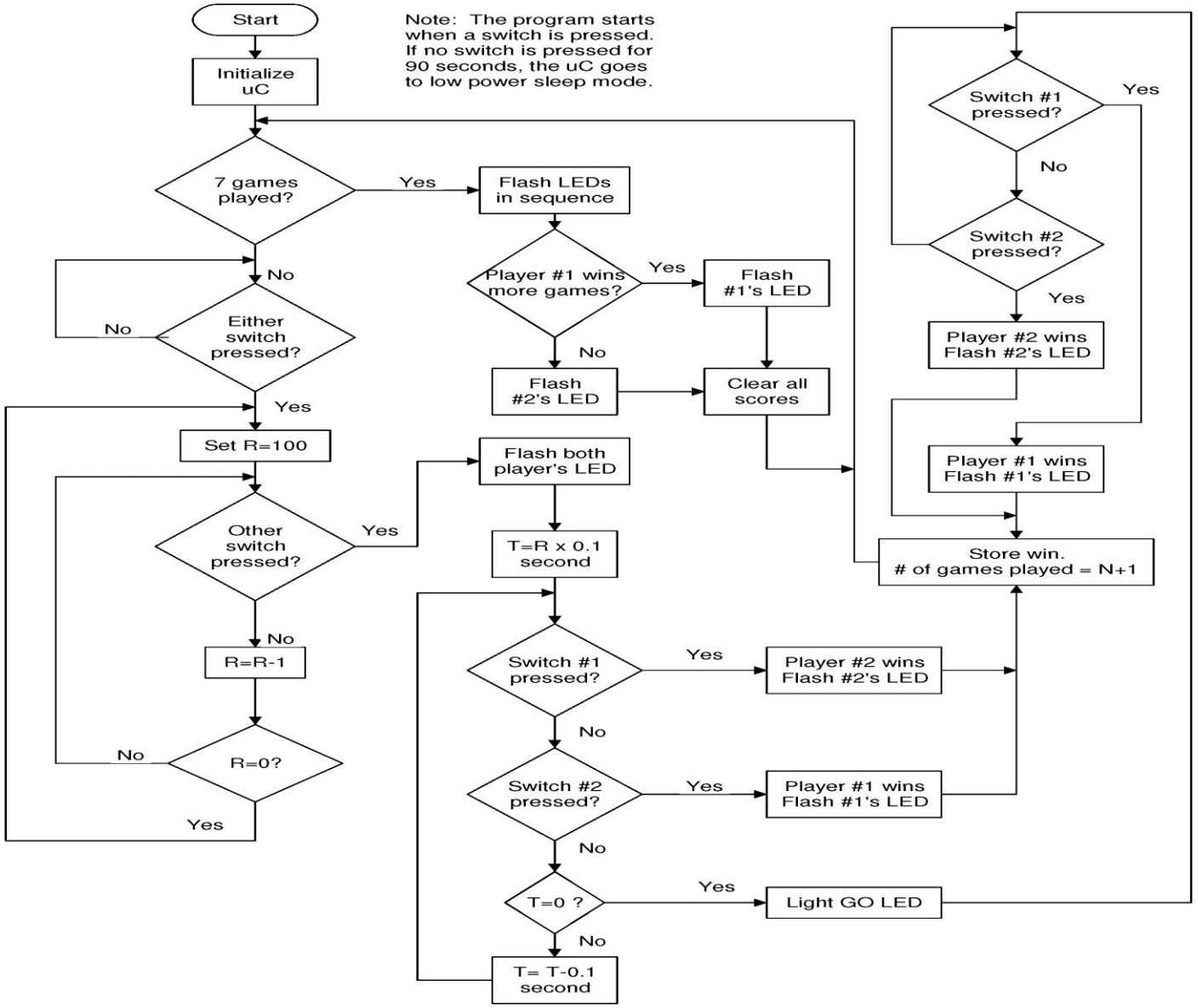
7. Install the zener diode D1 onto the pcb. The zener diode has a "polarity", or direction that it must be installed. Note that one end of the diode has a black stripe on it and that the marking on the pcb has a white stripe at one end. The black stripe on the diode must match the white stripe on the pcb.

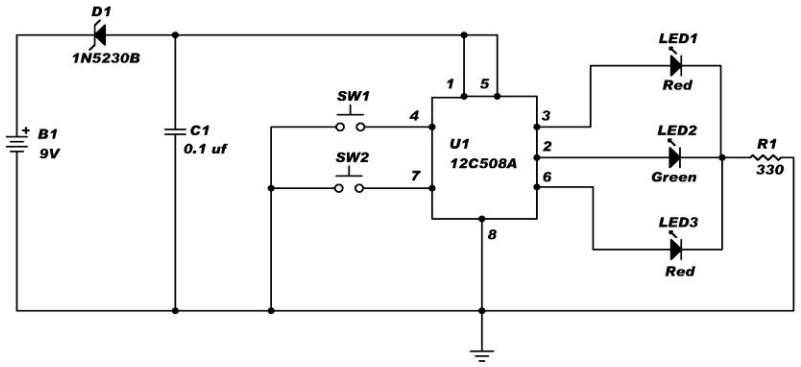
8. Install the PIC 12C508A at U1 on the board. Note that the PIC has either a notch or a dot at one end of the package. That notch or dot must be at the end of the board outline with the notch marking on the pcb.

9. Install both LED1 and LED3 (clear package) onto the pcb. Note that the diodes are polarized and that the bottom of the diode package (the "skirt") has a flat on one side. That flat must be installed to match the flat marking on the pcb.

10. Similarly, install the green LED2 onto the pcb.

Program Flow





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