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Instructions for the Single Bit Memory Board

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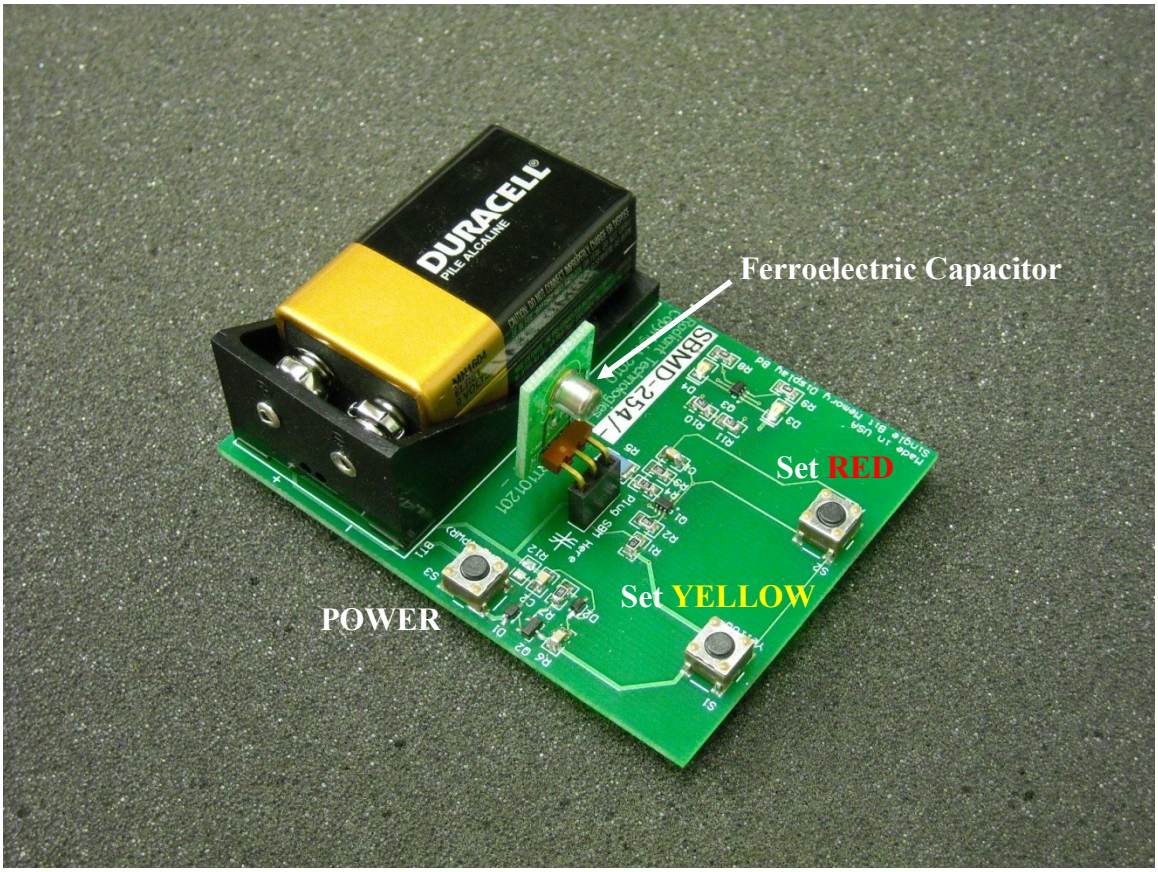
Introduction:

The Radiant Single Bit Memory board is a sample circuit demonstrating the operation of a stand-alone, autonomous non-volatile memory utilizing the unique properties of a ferroelectric capacitor. The ferroelectric memory capacitor is on a separate baby-board so it can be removed from the circuit by the user. For more information on ferroelectric capacitors, go to Radiant's web site at www.ferrodevices.com.



The circuit has three push button switches.

POWER	Applies power from the battery to the circuit. The circuit is only powered when this button is pushed. This is the READ button. Either the YELLOW LED or RED LED will illuminate when the POWER button is engaged.
SET YELLOW	Pressing this button ***while the POWER button is pushed*** will set the latch to illuminate the YELLOW LED. If the ferroelectric capacitor is installed, the circuit will program this state. When the POWER button is pressed in the future, the YELLOW LED will illuminate again.
SET RED	Pressing this button with the POWER button pushed will set the latch to illuminate the RED LED and program that state in the ferroelectric capacitor.

Operation:

1. With the ferroelectric capacitor OUT of the circuit, pressing the POWER button will always cause the RED LED to illuminate.

2. With the ferroelectric capacitor IN the circuit, pressing the POWER button will cause the LED color that was ***last illuminated*** to turn on again.

3. To set a new LED color, hold down the POWER button and press the desired color key: SET RED or SET YELLOW.

Experiments:

A. Memory demonstration:
   a. With the ferroelectric capacitor baby-board ***inserted*** in the circuit, set the LED color, and then release the POWER button.

   b. Press the POWER button again and note the LED color.

   c. Repeat the experiment for longer periods, for instance setting the color in the evening and checking it the next morning.

B. Portability Demonstration:
   a. The Type AD103 or Type AB103 ferroelectric capacitor on the baby-board is physically large enough (10,000 square microns) that it should not be affected by static discharge.

   b. With the ferroelectric capacitor inserted in the circuit, set the YELLOW color and release the POWER button.

   c. Press and release the POWER button again to verify the YELLOW color.

   d. Remove the ferroelectric capacitor board from its socket.

   e. Press and release the POWER button to read the stored color. The RED LED should illuminate.

   f. With the ferroelectric capacitor still removed from the circuit, execute the programming procedure to set YELLOW color. The YELLOW LED will remain illuminated as long as POWER is applied since this is a latch circuit.

   g. Release the POWER button to remove electrical power from the circuit.

   h. Press the POWER button to read the circuit state. The RED LED will illuminate since the circuit has no memory.

   i. Return the ferroelectric capacitor to its socket.

   j. Press the POWER button to read the circuit state. The YELLOW LED will illuminate.

C. Physical Polarity Demonstration:
    a. Program either a RED or YELLOW color in the circuit with the ferroelectric capacitor inserted.

    b. Remove the ferroelectric capacitor from its socket and re-insert it in the socket *facing the in the opposite direction.* The physical state of the ferroelectric capacitor is now reversed relative to the circuit.

    c. Press the POWER button to read the circuit state. The LED of the opposite color you programmed will illuminate.

    d. Reverse the orientation of the ferroelectric capacitor again.

    e. Press the POWER button to read the circuit state. The LED of the original color you programmed will illuminate.

D. Material Physics Demonstration
    a. Program a YELLOW state into the ferroelectric capacitor.

    b. Remove the ferroelectric capacitor from the circuit and measure the voltage between the two outside leads of the board with a volt meter. *The voltage across the ferroelectric capacitor will be zero.*

    c. Replace the ferroelectric capacitor and read its state. The YELLOW LED should illuminate.

    d. Repeat the experiment in the RED state.

    e. How can there be no voltage but the data is the capacitor?

Conclusions

1) The ferroelectric capacitor enables the Single Bit Memory circuit to remember its last state and return to that last state when power is applied again.

2) The data bit stored in the ferroelectric capacitor is a ***physical*** change to the material inside the capacitor. The data is not a voltage stored on the capacitor as with a Dynamic RAM in a computer.