INSTRUCTIONAL GUIDE FOR CIRCUIT LAYOUT AND WIRING PRACTICES ON BREADBOARDS INCLUDES DIGITAL CIRCUITS

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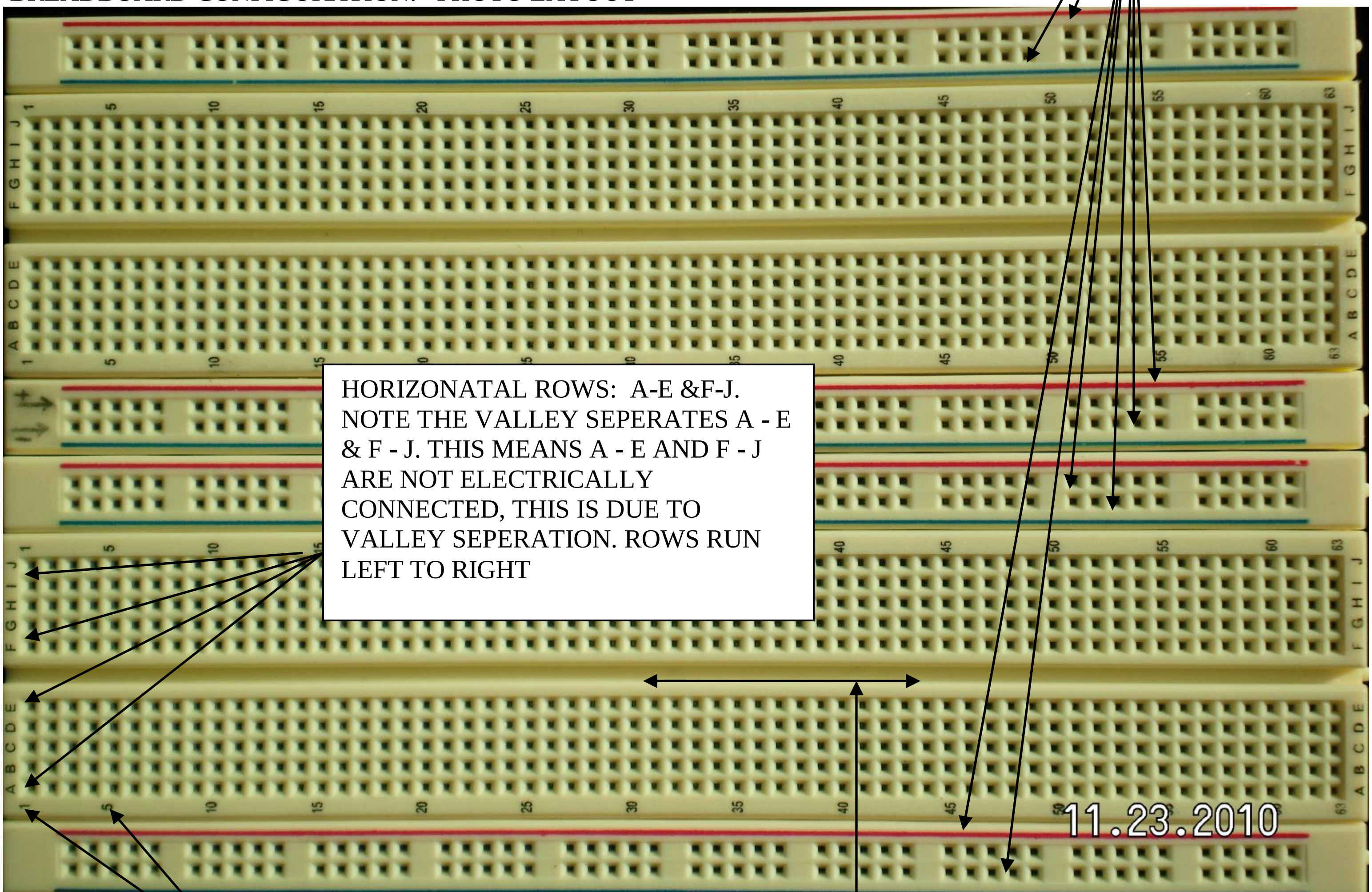
POWER RAIL, LOCATED AT THE TOP AND BOTTOM OF BOTH BOARDS; RED LINE FOR + VOLTAGE, AND BLUE LINE FOR NEGATIVE VOLTAGE OR GROUND CONNECTIONS

BREADBOARD CONFIGURATION: PHOTO LAYOUT



HORIZONATAL ROWS: A-E &F-J. NOTE THE VALLEY SEPERATES A - E & F - J. THIS MEANS A - E AND F - J ARE NOT ELECTRICALLY CONNECTED, THIS IS DUE TO VALLEY SEPERATION. ROWS RUN LEFT TO RIGHT

COLUMN NUMBERS. NUMBERED EVERY 5 SPACES. COLUMNS ARE NOT ELECTRICALLY CONNECTED, LEFT TO RIGHT. COLUMNS RUN UP & DOWN, ELECTRICALLY CONNECT, IE, A-E THEN F-J.

VALLEY SEPARATION, SEPARATES TOP HALF OF BOARD FROM THE LOWER HALF

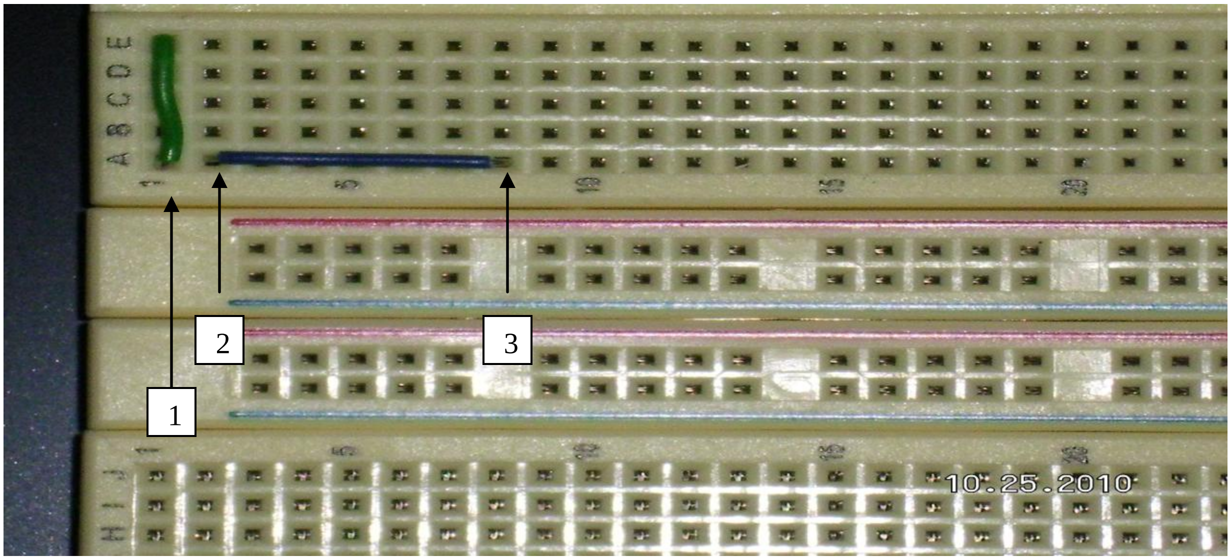
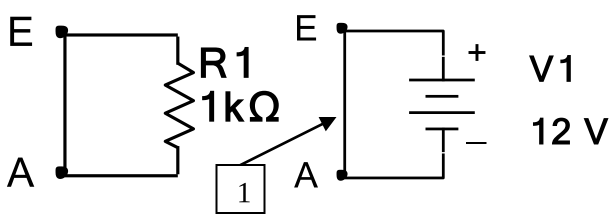


DIAGRAM A

DIAGRAM A: Grid pattern layout of breadboard. Looking at vertical column A through E the feed through connections are electrically the same. In other words, looking at jumper wire #1, the top and bottom of the jumper are electrically at the same point. This is a short. If a power supply were connected with positive (+) in A and negative (-) in E, this would short out the power supply.

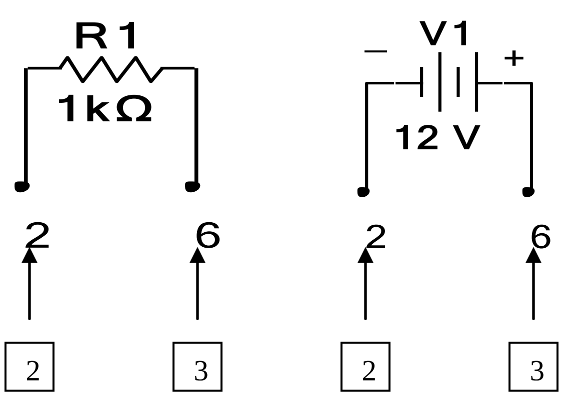
Diagram A: Looking at jumper 2 (arrow points 2 & 3), this is on the horizontal plane. Examination of this section of the board reveals a numbering sequence from left to right. The numbers are spaced every 5 points (feed through). Jumper 2 has contact points in feed through 2 & 6. This does not represent an electrical short. Schematic diagram 2 shows electrical connections.

SCHEMATIC REPRESENTAION OF ELECTRICAL CONNECTIONS



Schematic diagram 1: arrow #1 is pointing to the same electrical connections made on the breadboard. As shown, points A and E are electrically shorted (arrow 1 points to jumper wire 1). Diagram of power supply clearly shows a short between the positive and negative terminals.

Schematic diagram 2: The two diagrams showing arrows 2 & 3 are not electrically in the same contact points 2 & 6. This represents the proper wiring procedure for the breadboard.



INVESTIGATION OF POWER RAILS

Located at the top and bottom of the breadboards are two power rails. The red line indicates the positive rail. The blue line represents the negative rail. The electrical connections run left to right, even though the spaces between them are every 5 holes they are still in the same row connection. External power supply should always make connection into the power rails and distributed into the circuitry built on the board from there. Making connections directly to the circuit puts the supply in the way for making the measurements needed.

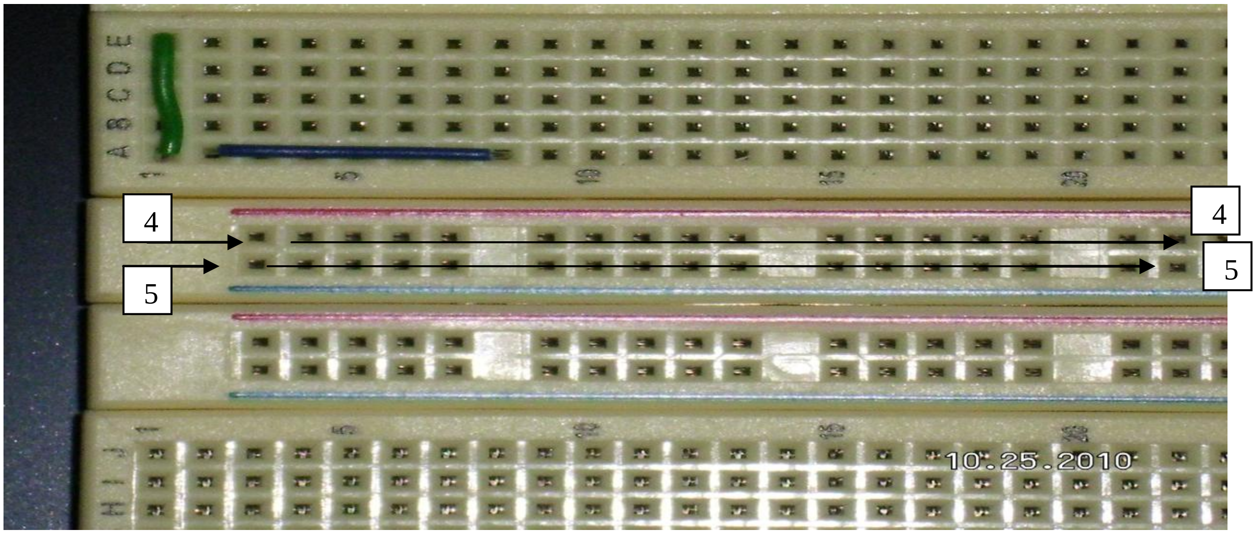


PHOTO: POWER RAILS

Arrows 4 & 5 indicates the power rail configurations. The rails are colored RED and Blue. There are two power rails on the top and bottom of each board. The trainer incorporates two breadboards per unit. Power rails run from left to right and have a space between them every five feed through. Proper setup should start with a basic connection to each rail. This is the connection from an external power source from lab bench. Distribution of the external supply from power rails to the circuit is less confusing and leaves out the possibility of shorting the supply out. Proper distribution of the power source is located in the following photos. Different configurations are available and are not limited to one way. Once knowledge of the breadboard progresses, configurations are numerous. Clean layouts allow for easier access to measurements within a circuit.

PHOTO: POWER RAIL CONNECTIONS

PHOTO A

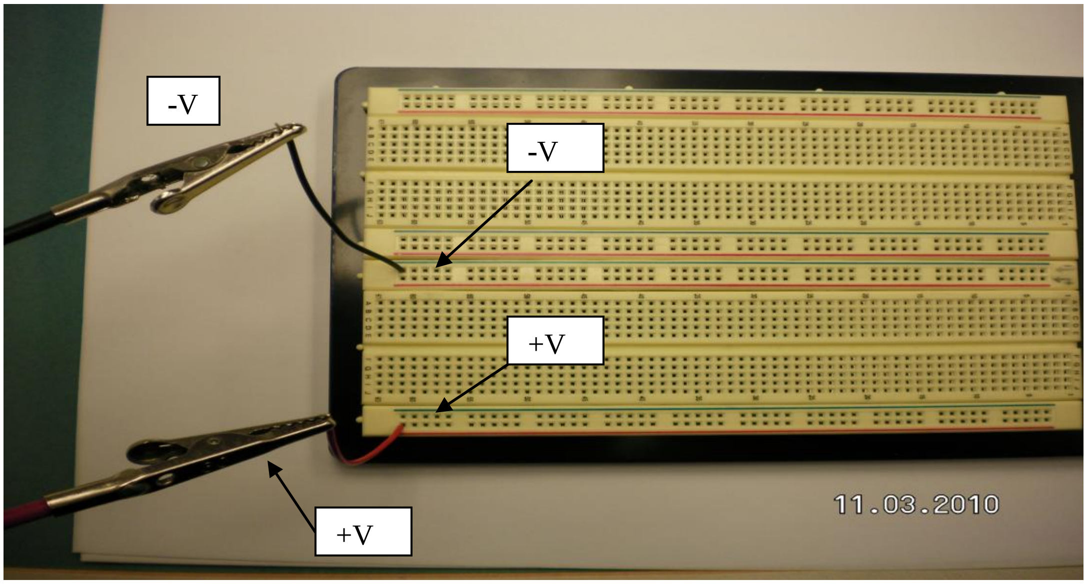


PHOTO: A

The above photo shows proper connections from the external power supply into the breadboard. This configuration has the lower board wired in. The negative made at the blue or common rail. The positive lead made at the red rail or positive +Voltage rail. This allows the power from the external supply at one end of the board, and distribution from the rails is easier and less confusing. The top board now, if called for, wired with a second supply. This configuration will allow for dual supplies, if the circuitry requires this.

CIRCUIT LAYOUT PHOTOS:

Series circuit layouts

Improper configuration photo A

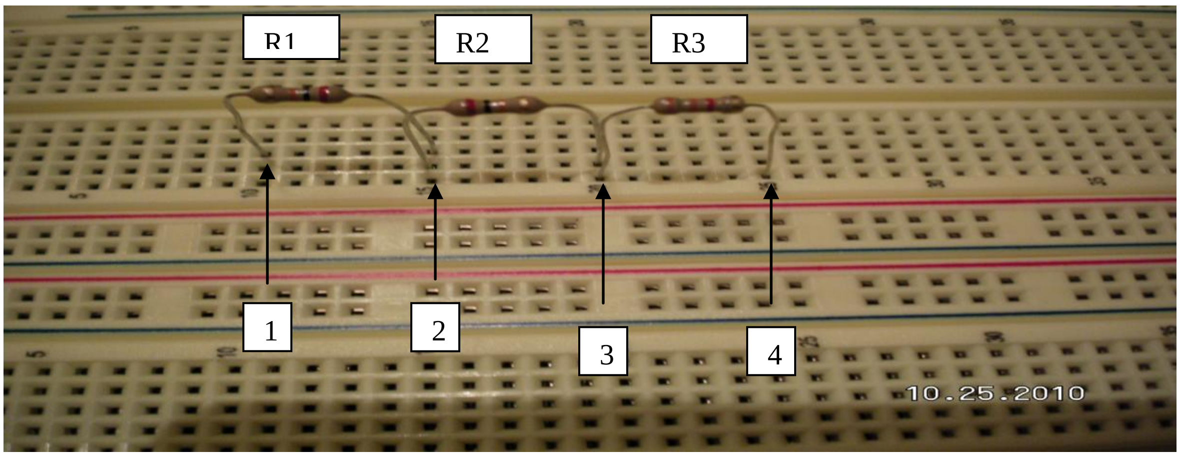


Photo A: The guide arrows show the typical wiring of a simple series circuit. Arrow 2 shows the connection made between R1 & R2, arrow 3 makes the connection between R2 & R3. This is a flawed layout. Power and ground not shown photo.

1.) Resistors wired in a small-contained area.
2.) Layout prevents easy access to circuit for measurements and powering up the series circuit.
3.) Meter placement is almost impossible; circuit not powered in photo

PHOTO B:

PROPER CONFIGURATION OF A SERIES CIRCUIT

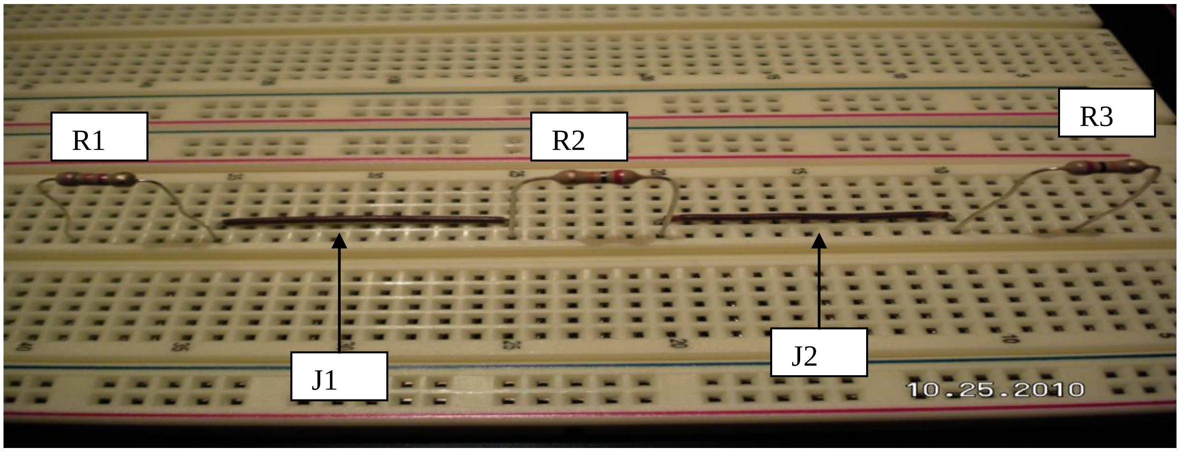


Photo B: Jumpers 1 & 2 now make the connections between resistors R1 & R2. This configuration shows a proper layout. Complete layout will follow these basic circuit layouts.

1) Resistors are well spaced for easy access for measuring voltage and current.
2) Power and ground are easy to wire to circuit from the power rails.

PHOTO: C

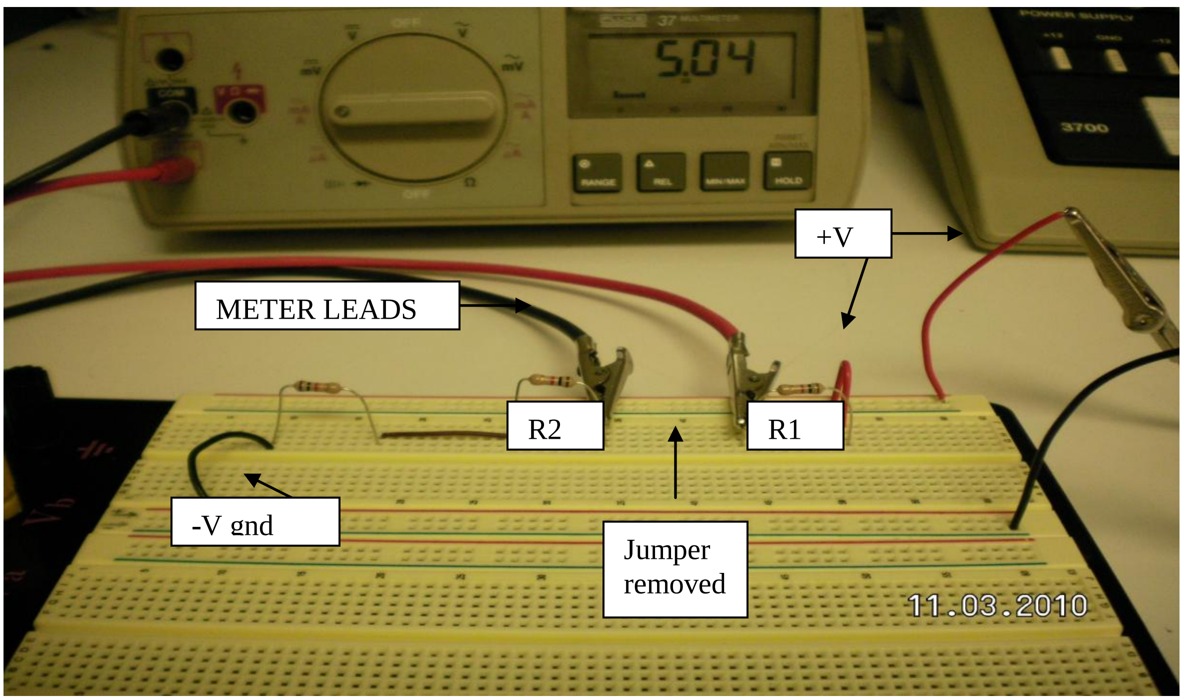


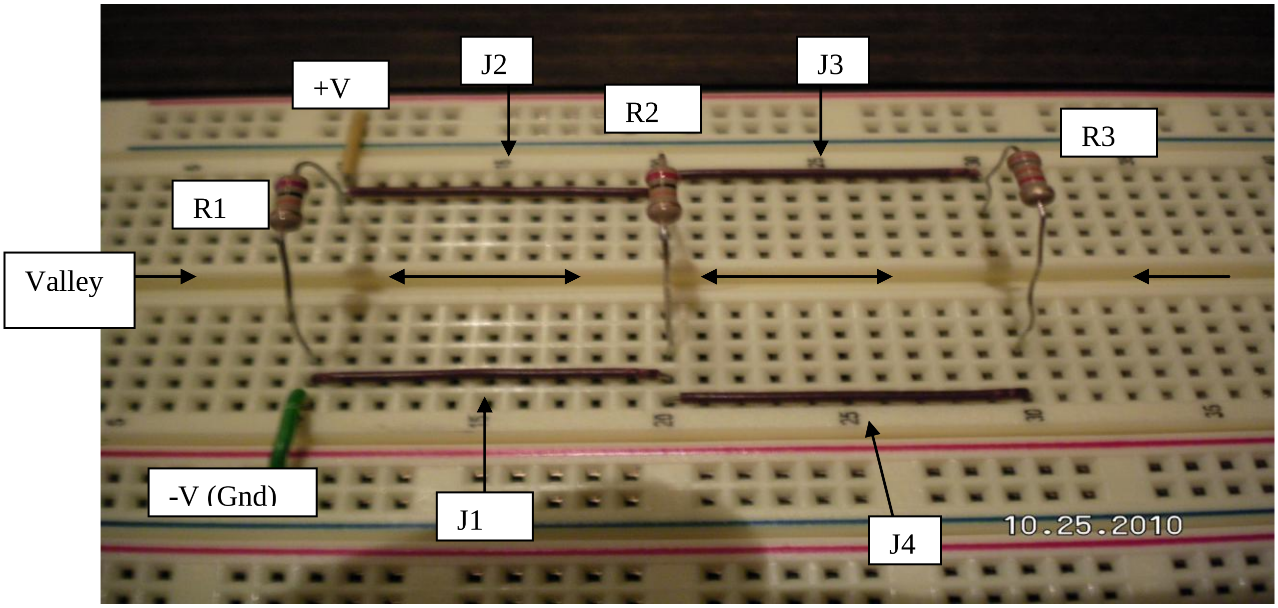
PHOTO: C

Photo C shows the same series circuit in photo B with proper power and meter configurations for laboratory measurements. Proper protocol in wiring the circuit allows for easier measurements. Simplicity is the key.

1.) Power brought into end of board, +V and –V (GND) brought up to circuit from power rails.
2.) Jumper leads between R1 & R2 removed for meter lead placement and taking current reading shown.
3.) Meter is set to current and now displays the current reading for the series circuit.

PARALLEL CIRCUIT WIRING

PHOTO C:



NOTE: PHOTO DOES NOT SHOW EXTERNAL SUPPLY CONNECTIONS TO THE POWER RAILS. POWER TO THE RAILS ARE THE SAME AS SERIES CIRCUIT PHOTO. THIS CONFIGURATION DOES NOT CHANGE FROM CIRCUIT TO CIRCUIT.

Photo C: Show the typical parallel circuit layout. Resistors 1, 2, and 3, placed into the breadboard bridging the gap or valley in the center of the board. The valley separates the top half of the breadboard from the bottom half. Refer to first photos on page one for valley configuration. Photo C is one of two parallel layouts, which allows for current measurements between resistors. The next photo shows the best layout for current measurements of each resistor. Considerations of combinations of both layouts are feasible for lab experimentation.

PHOTO: D
PHOTO SHOWS POWER AND GND FROM POWER RAILS WITH METER LEADS

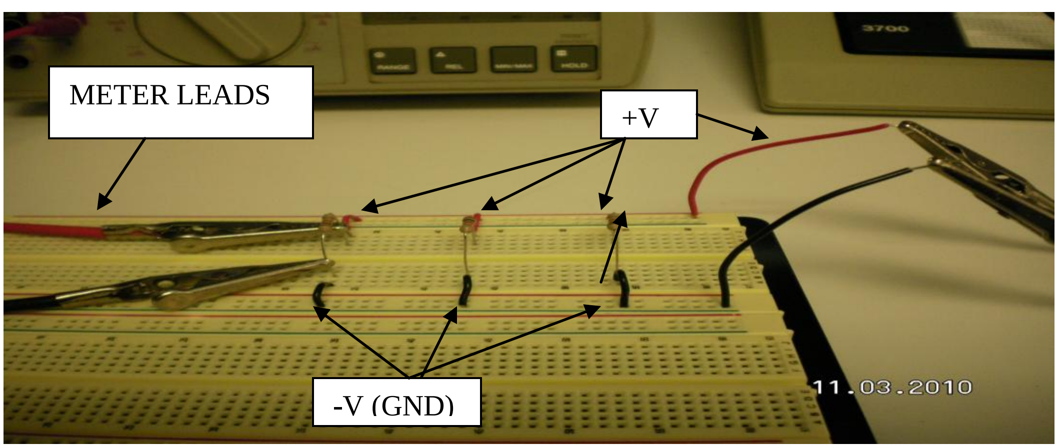
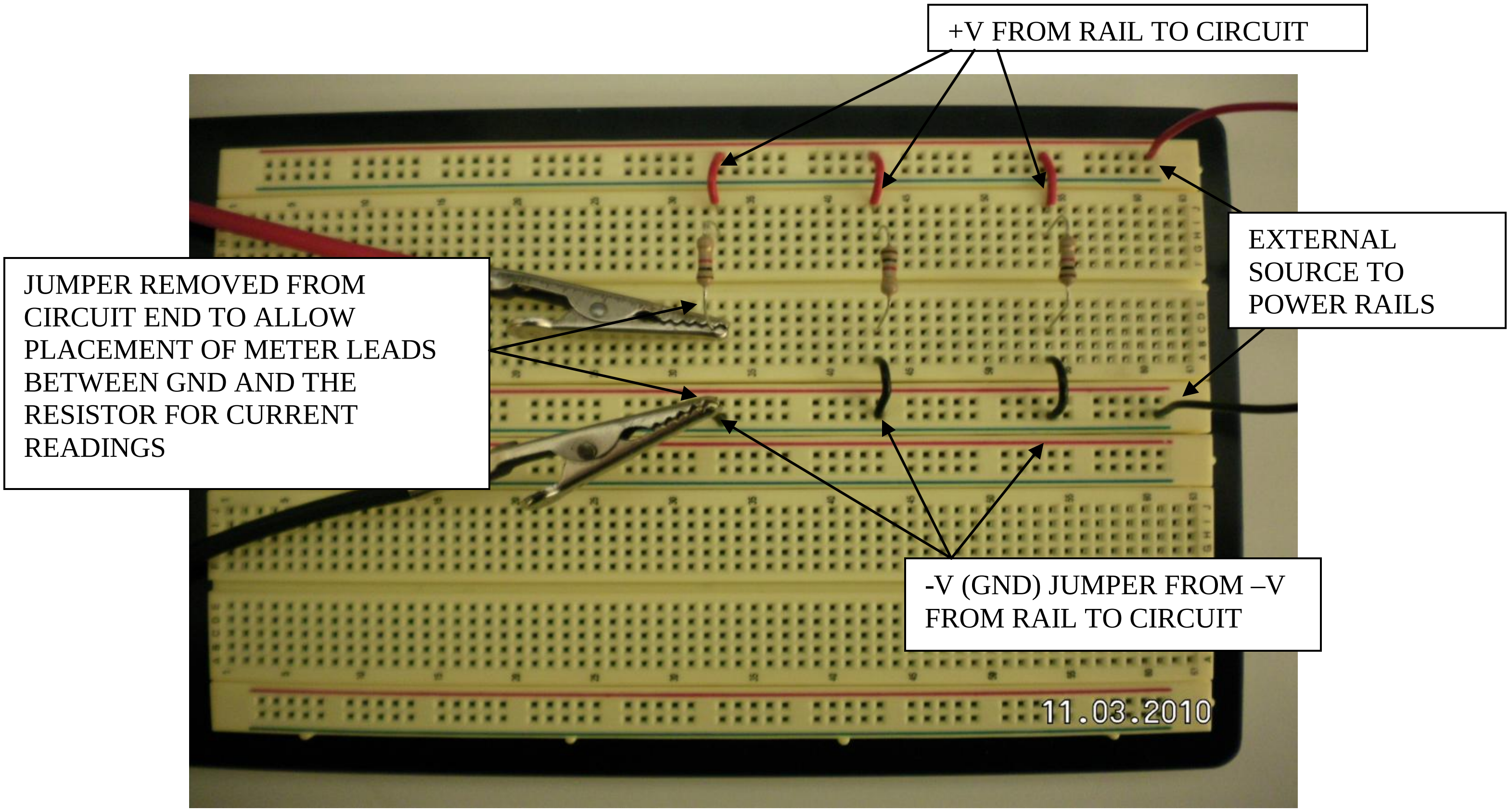


PHOTO FOR PARALLEL CIRCUIT SETUP FOR INDIVIDUAL CURRENT MEASUREMENTS



The above photo incorporates a common layout for a parallel circuit for individual current readings. This is a simple layout; circuit not cluttered into one tiny space, the key, spread them out. Remember spreading the circuit out will allow circuit measurements easier to take. The lab experiment will dictate the type of configuration used.

THE NEXT FEW SETUPS WILL SHOW PROPER DIGITAL WIRING, THE DO’S AND DON’TS

SHOWN IN THESE PHOTOS ARE LAYOUTS OF PROPER WIRING AND CONFIGURATION

IMPROPER WIRING OF DIGITAL CIRCUIT.

PHOTO: A

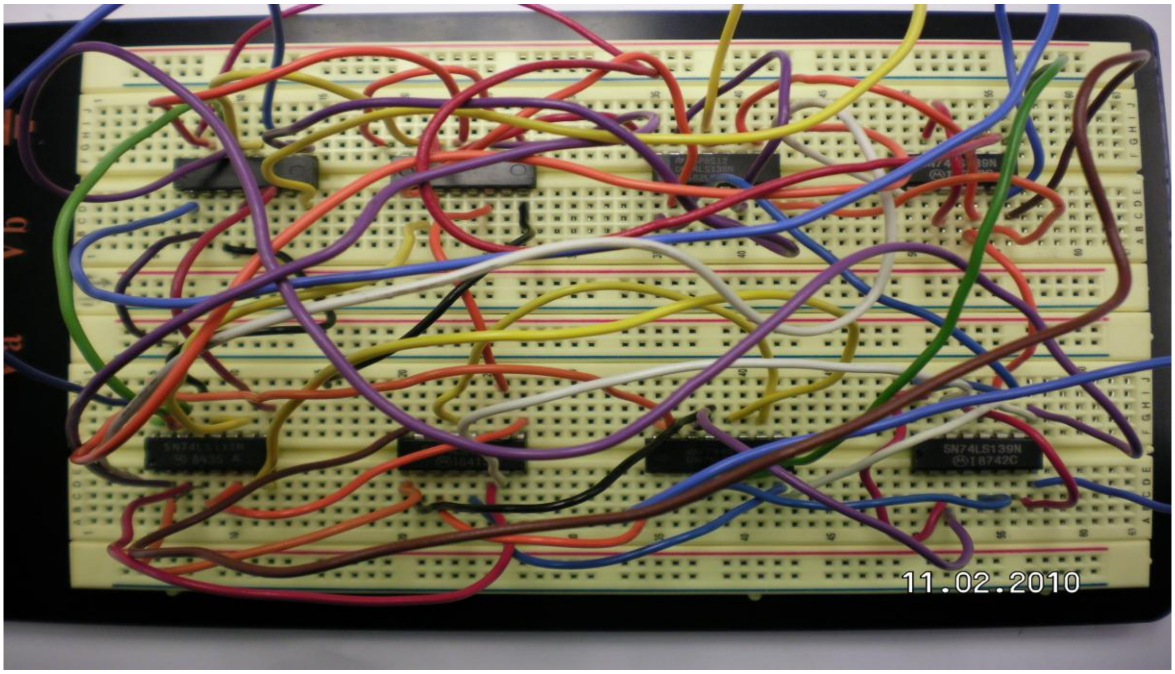


PHOTO A: The above photo shows the wrong way to wire IC’s to the breadboard.

1.) Wires are in a bird nests configuration.
2.) Wires crossover the IC’s.
3.) Color scheme: RED and BLACK colors used to wire IC’s to each other.
4.) Multiple colors use to wire chips to each other.
5.) Circuit is hard to troubleshoot due to bird nest.
6.) Remember if you cannot identify the circuit connections, no one else can.
7.) IC’S straddle the valley, one-half of IC on each side of the valley. (this is correct)

Here are a few corrections to the setup. The colors Red and Black should only be used to wire up the power and ground to the IC’s. However, the photo though in black and white does have multiple color wires used in wiring up the circuit. When signing out digital lab kits, several feet of colored wired go with the kit. Since wires are in lengths of about 2 -3 ft, cut wire to length needed for circuit for wiring. If possible, pick a color for a different function in the circuit. This process will allow for easier section identification of various functions within a sequential circuit, I.E. clock, memory, control, decoding. Sometimes, it is impossible to keep color separation within a circuit, Due to the limit of the color schemes used.

PROPER CONFIGURATION FOR A DIGITAL CIRCUIT

PHOTO B

VALLEY

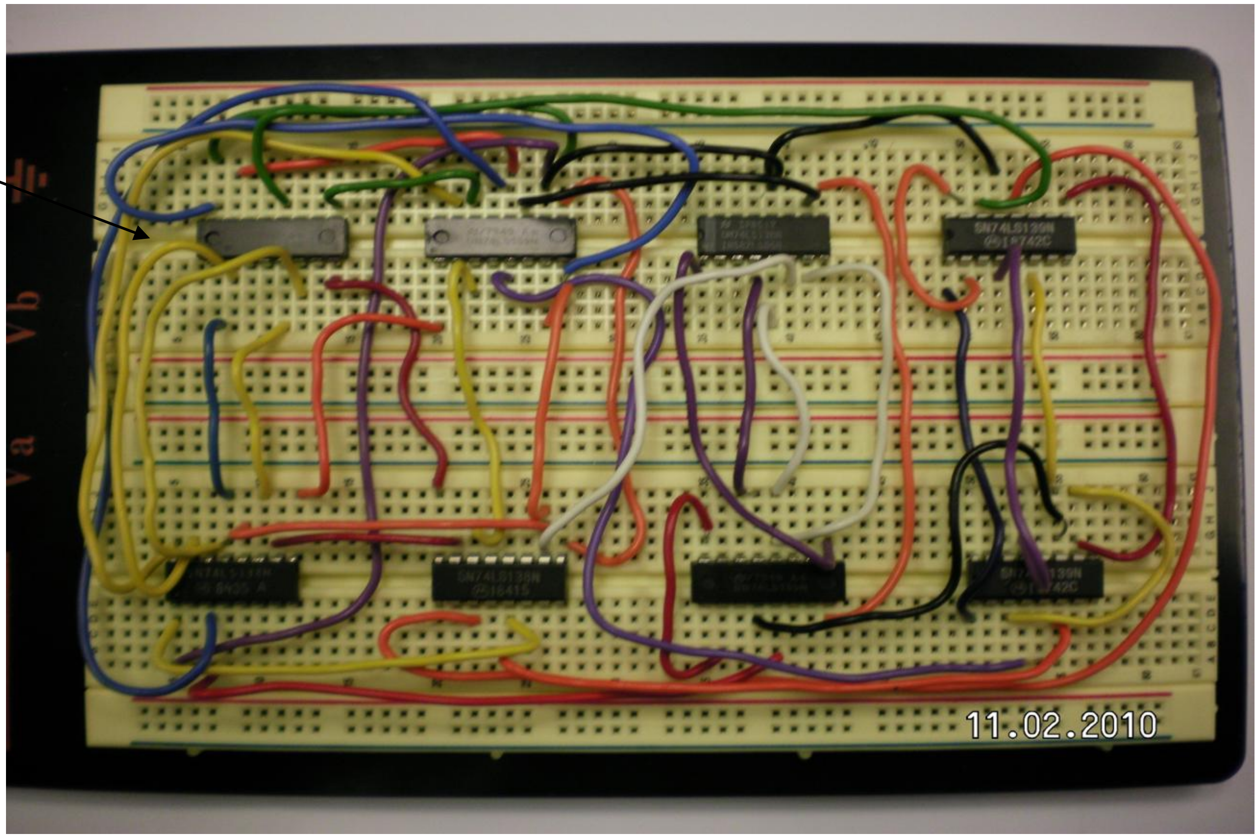
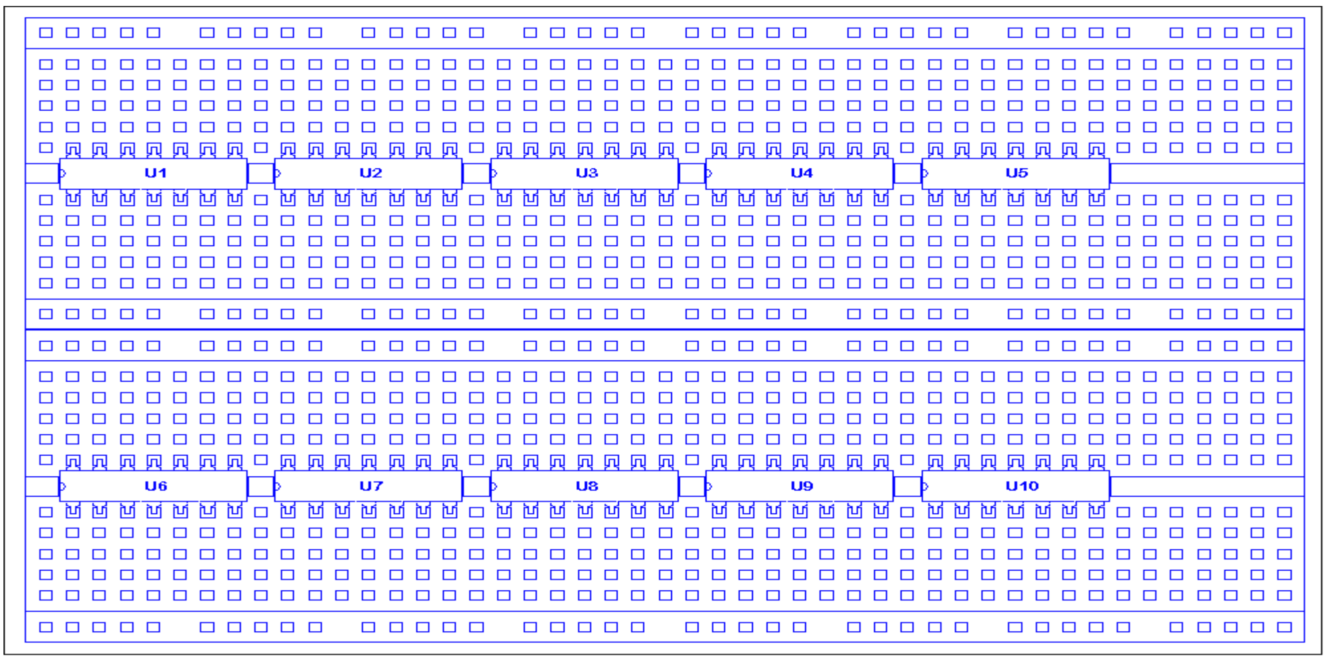


PHOTO B: Here again multiple colors were used to wire up the circuit. The above circuit is not an actual working circuit. Circuit photo shows proper wiring of circuit. Circuit tracing for bad connections and defective chips can now be traced much easier. Power and Ground supplies not shown. IC designation will follow in the next few diagrams.

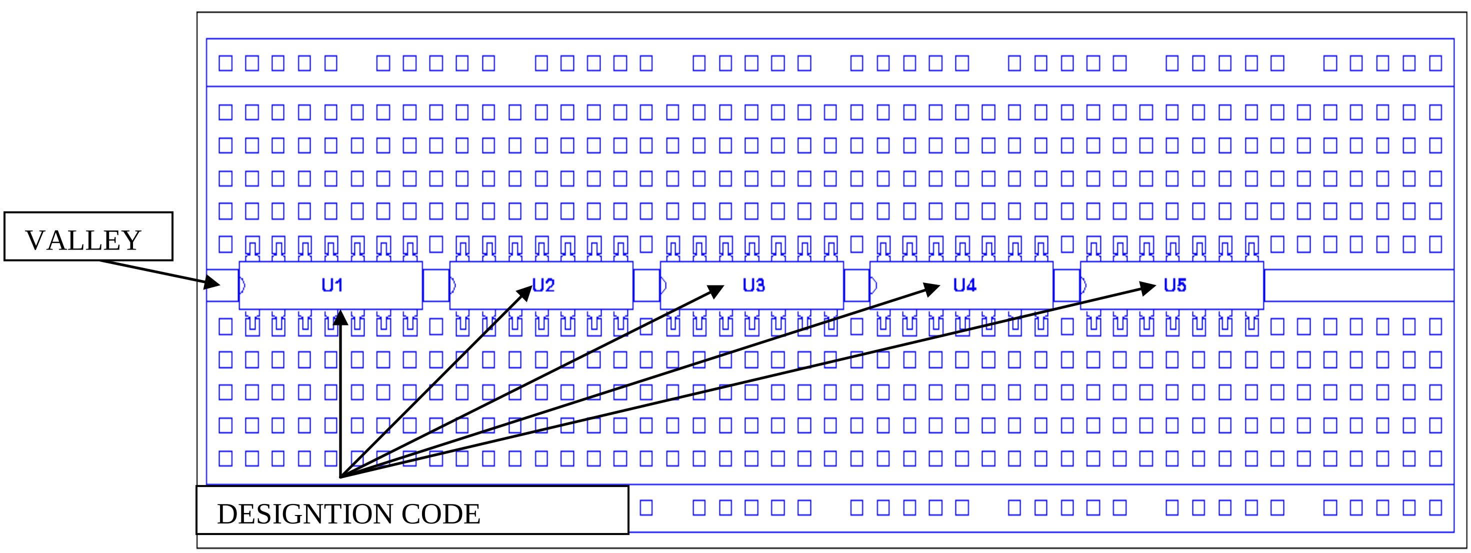
1.) Wires are short and low to the board.
2.) Wires do not crossover the IC'S
3.) Identification of IC'S are now seen, I.E. 74LS7408, 74LS00, etc.
4.) Designation of IC placement is easy to follow, I.E. U1, U2, etc.

Reference Designator Numbering Sequence for a Lab Proto-board

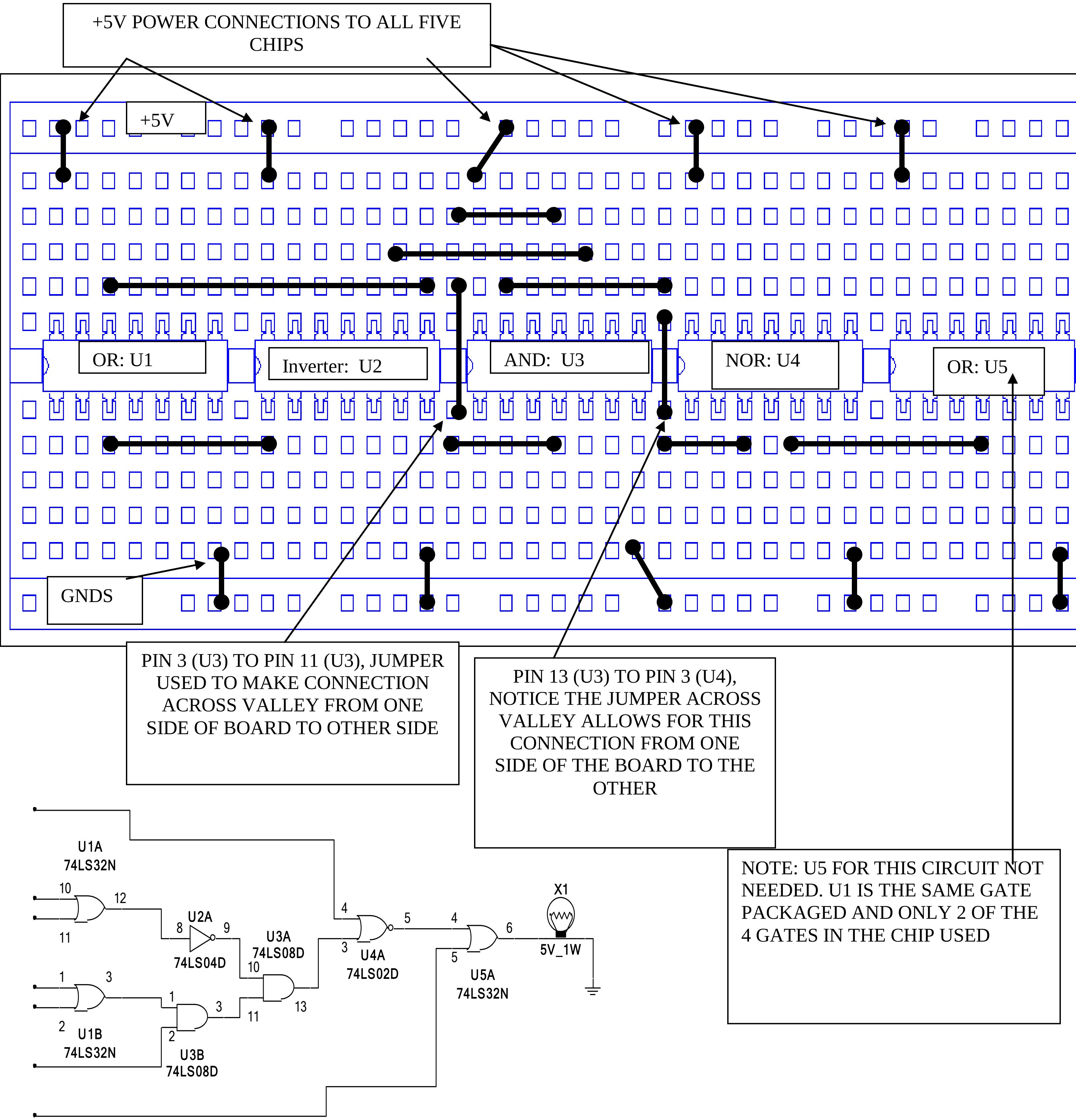
The follow breadboard layouts show how giving a designation reference code allows for the tracing of faults. In the combinational circuits tracing one gate to another are easily identified, most gate IC'S have several gates within a given package. Example of this, the 74LS008 is a quad package. The quad package indicates there are four of these types of gates in that particular IC. Now that each chip has a designation code, tracing from one chip to another is achievable.



THE TOP LAYOUT SHOWS TWO BOARDS, LOWER HAS ONE BOARD LAYOUT



THIS PAGE SHOWS A GRAPHICAL WIRING LAYOUT OF A DIGITAL CIRCUIT.
NOTICE IC DESINATION NUMBERS



NOTE: LAMP AND LOGIC SWITCHES NOT SHOWN; CIRCUIT USED IS FOR GRAPHICAL WIRING REPRESENTATION ONLY, NOT FOR FUNCTIONALITY