

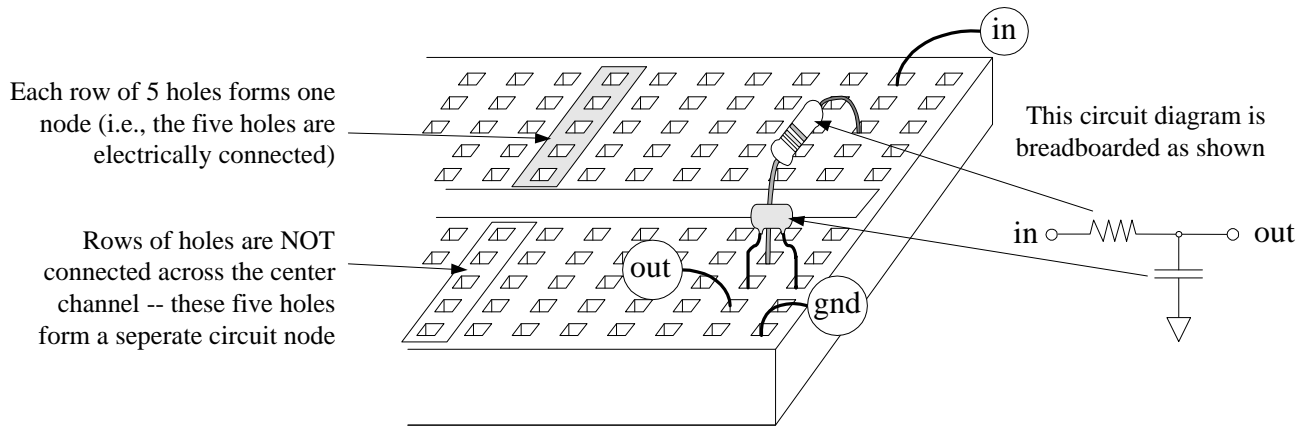
# Breadboarding with Digilab XL

## Overview

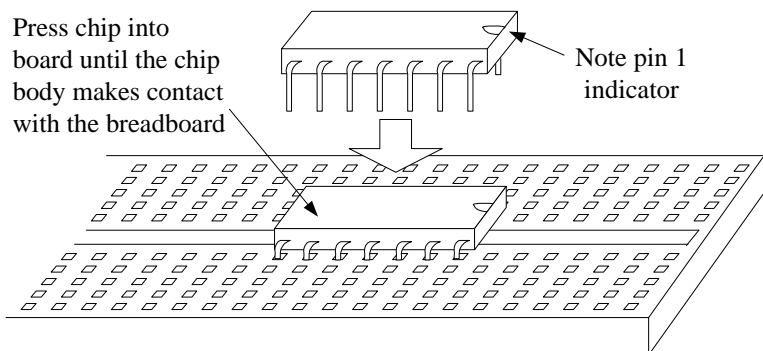
This document describes in general terms how circuits can be implemented from individual or discrete components using the Digilab XL circuit board. Although this document has been written to accompany the Digilab board, the concepts are generally applicable to any breadboard design, whether using the Digilab board or not.

## Background

Breadboarding refers to the process of rapidly creating experimental and prototype circuits using a circuit board (called a breadboard) that has been designed for just that purpose. Breadboards have grids of “through-holes” that are designed to accept component leads with very little effort – a lead can simply be pushed into a hole. A typical breadboard has rows of five or six holes that are electrically connected into a single circuit node. When a component lead is inserted into one of the five holes, the remaining four holes are connected to that lead as well. Therefore, components leads or jumper wires that are inserted into a row with other component leads or wires will form a single circuit node (jumper wires are .22 or .24 gauge wires that have been stripped of about ¼” insulation on both ends). Using a breadboard allows components and interconnections to be rapidly added, studied, and modified.



Digilab’s breadboard has 630 “tie-points” (or through-holes) arranged as 126 rows of five holes each. A center groove divides the groups of five holes – holes are not connected through this central groove. This groove allows components in DIP packages to be placed in the breadboard without “shorting” (or connecting) their leads. When inserting a chip into the breadboard,

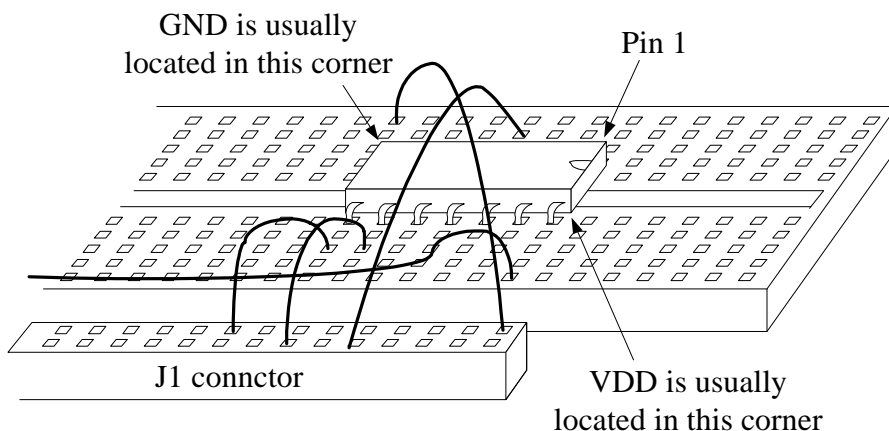
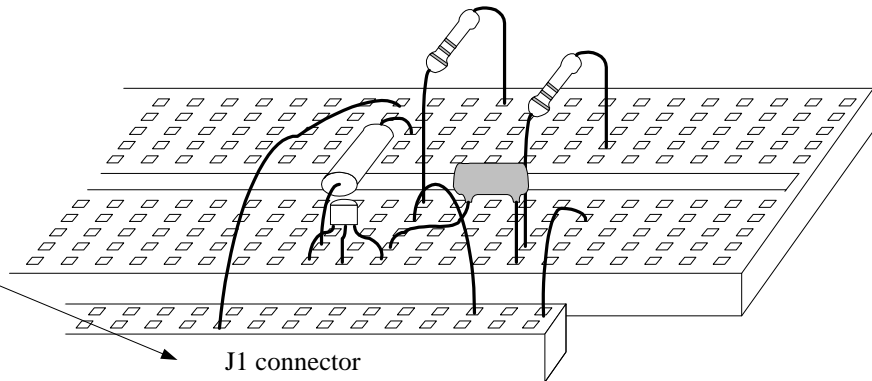


make sure that it straddles the central groove, and that it is pressed into the breadboard far enough for the chip's body to contact the surface of the breadboard. If a chip is inserted so that it does not straddle the central groove, pins on opposite sides will be shorted together; if it is not pressed all the way into the breadboard, component pins may not make contact with the other four holes on that breadboard row.

The breadboard can receive any components whose lead diameters are 50 mils or less, provided the leads can be manipulated to fit 100-mil spaced holes. Any standard small-signal resistors, capacitors, inductors, transistors, diodes, switches, and other passive components can be used. Many different IC's can also be used, and in particular those in standard DIP packages. Note that although the Digilab board uses a 5V supply, up to 12 volts can safely be used for signal conditioning circuits on the breadboard area (although a 12V signal should never be connected to one of the permanent IC's on the Digilab board!).

The large connector labeled J1 on the Digilab board has been placed near the breadboard so that the switches, buttons, LEDs and other devices on the Digilab board can easily be incorporated into breadboard circuits. In fact, the J1 connector was specifically designed to act as a small, pre-defined breadboard where one side of all the connections are pre-connected to useful devices. For example, to use an LED in a breadboard circuit, the circuit node that will drive the LED can be connected to the J1 connection labeled LED1 by a jumper wire. Or, if a circuit requires inputs that can switch between Vdd and GND, then input nodes can be connected to Digilab's switches (the SW connections on J1) or buttons (the BTN connections on J1).

Components leads can be inserted into breadboard and interconnected with wire jumpers. Circuits can be connected to Digilab components by jumping breadboard circuit nodes to J1 connections.



Digital circuits can be built from discrete IC's ("or chips") by inserting wires into breadboard holes to connect the chip's VDD, GND, and input and output pins. Inputs may come from buttons and switches, and outputs may drive LEDs -- connections for all these devices are available on the J1 connector.

When breadboarding a digital circuit, certain leads (or “pins”) on the chip must be attached to a voltage source, and certain other pins must be attached to ground. The difference in voltage between the voltage source pin (typically labeled Vdd or Vcc) and GND provides the electrical power required by the chip. On the Digilab board, Vdd and GND connections are available at several locations on the J1 connector – jumper wires can be used to connect the J1 source pins to the appropriate pins on chips. A typical digital chip in a DIP package uses a single pin opposite pin1 for the Vdd connection, and a second pin in the opposite corner for a GND connection. Some digital IC’s and most analog IC’s do not use standard locations for Vdd and ground pins. In any case, you should consult a chip’s data sheet to find pin definitions prior to connecting it in a circuit. All other pins on a chip are for inputs and outputs, and they are connected according to the requirements of the circuit being constructed.

### **Breadboard Procedure**

To breadboard a logic circuit using DIP chips, the following general procedure can be followed.

1. Obtain a data sheet or other reference source showing the names, functions, and locations of all pins on the chip.
2. Press the chip into the breadboard so that it straddles the center groove.
3. After making sure that the Digilab board is unplugged, connect the Vdd and GND pins of the chip to the Vdd and GND connections on J1.
4. Connect the input and output pins of the chip as indicated by circuit requirements. For inputs that must come from buttons or switches, use wires to connect the chip inputs to the appropriate input connections on J1. For outputs that must drive LEDs, connect the chip outputs to the appropriate LED connections on J1.
5. Plug in the Digilab board, and ensure the power-on LED illuminates. If it does not illuminate normally, unplug the Digilab board and look for any short-circuits in your breadboard circuit (recall a short-circuit occurs when Vdd is connected directly to GND).
6. Test your circuit to verify it meets the given design requirements.
7. Unplug the Digilab board and dismantle the circuit.