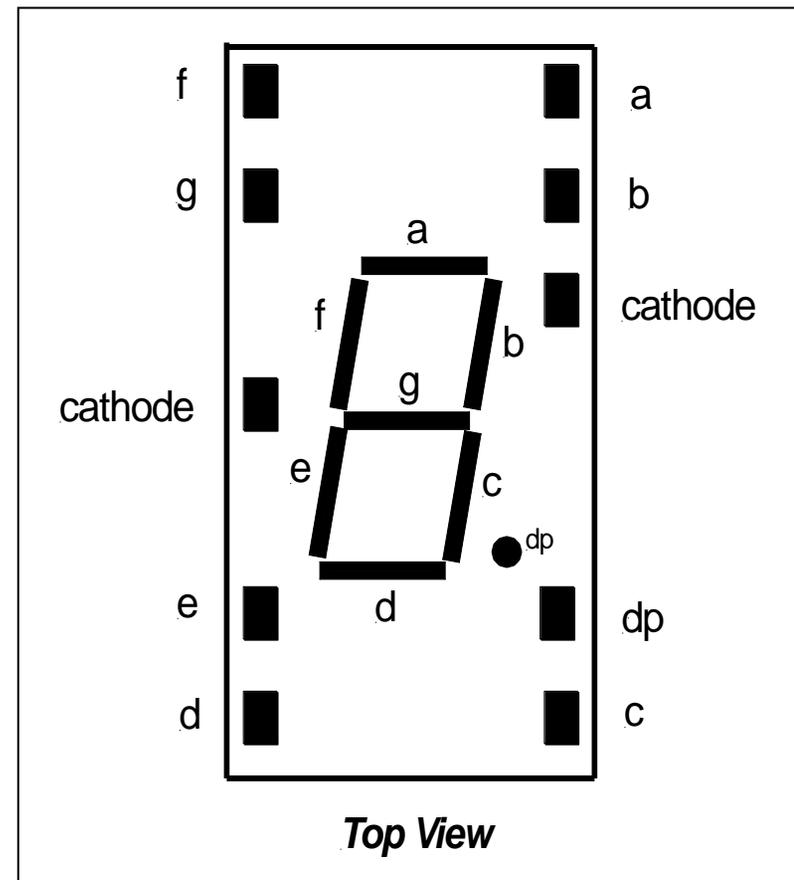
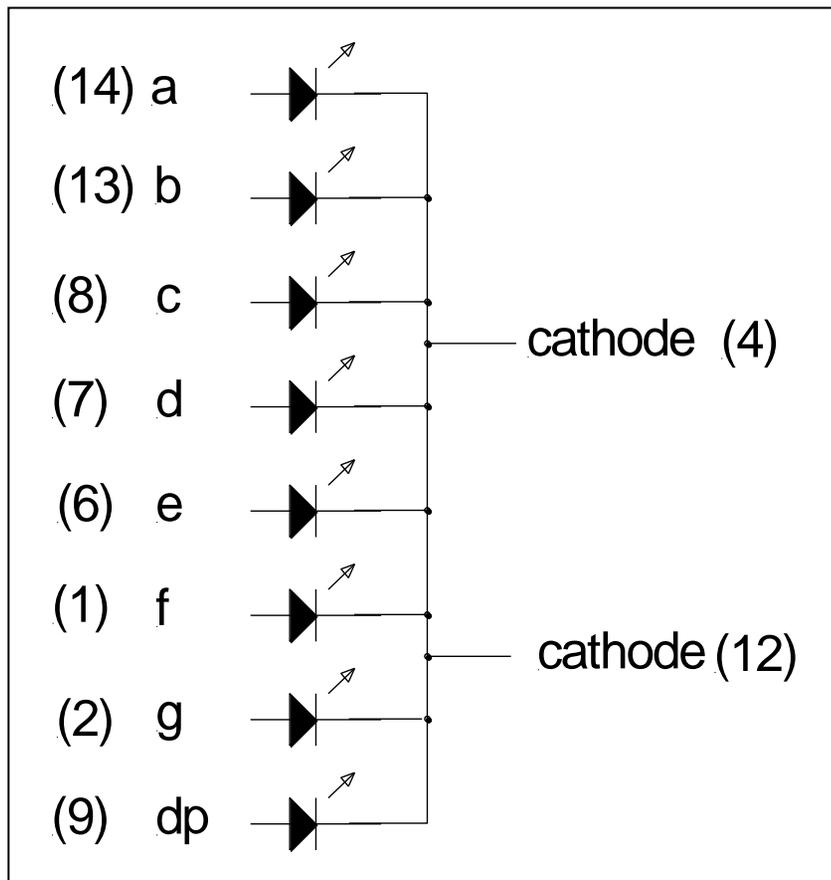


Lab 12

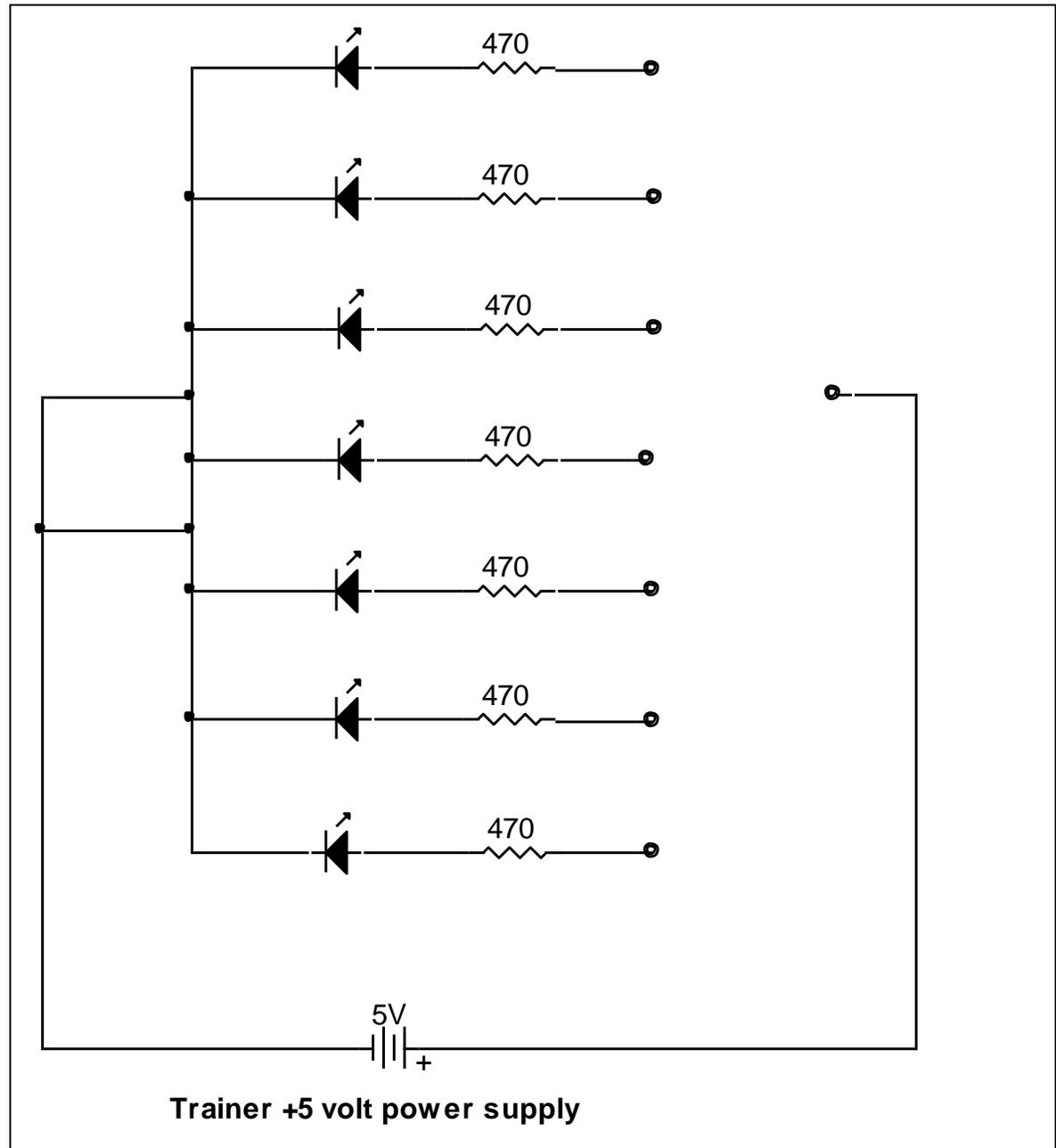
Displays, Drivers, Counters

An LED digital display such as the MAN-74 (Monsanto Alpha-Numeric #74) contains eight LED diodes connected such that they can form all the Arabic numerals 0-9 plus a decimal point. The display is arranged like this:



Lab Instructions:

1. See the last page for a Lab Aid in hooking this lab up.
2. Set the positive power supply on the trainer to 5 volts or use the 5 volt (red binding post) output directly.
3. Place the MAN-74 onto the trainer. Connect the negative side (ground) of the power supply to BOTH cathode pins.
4. Put a 470 ohm quarter-watt resistor in series with the 7 lettered pins a through g (7 resistors).
5. One at a time, touch the positive lead of the power supply to the free end of the resistor and notice that the appropriate display segment lights up.
6. By means of multiple wires (up to 7), form all the numbers 0-9. Do the ones digit first by lighting up segments b and c (pins 13 and 10). Then digit 2, 3, and so on through 9 and 0.



Now let's automate the process. Here is the instructions for how to make this into an driver:



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October 1987
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CD4511BC BCD-to-7 Segment Latch/Decoder/Driver

CD4511BC

BCD-to-7 Segment Latch/Decoder/Driver

General Description

The CD4511BC BCD-to-seven segment latch/decoder/driver is constructed with complementary MOS (CMOS) enhancement mode devices and NPN bipolar output drivers in a single monolithic structure. The circuit provides the functions of a 4-bit storage latch, an 8421 BCD-to-seven segment decoder, and an output drive capability. Lamp test (LT), blanking (BI), and latch enable (LE) inputs are used to test the display, to turn-off or pulse modulate the brightness of the display, and to store a BCD code, respectively. It can be used with seven-segment light emitting diodes (LED), incandescent, fluorescent, gas discharge, or liquid crystal readouts either directly or indirectly.

Applications include instrument (e.g., counter, DVM, etc.) display driver, computer/calculator display driver, cockpit display driver, and various clock, watch, and timer uses.

Features

- Low logic circuit power dissipation
- High current sourcing outputs (up to 25 mA)
- Latch storage of code
- Blanking input
- Lamp test provision
- Readout blanking on all illegal input combinations
- Lamp intensity modulation capability
- Time share (multiplexing) facility
- Equivalent to Motorola MC14511

Ordering Code:

Order Number	Package Number	Package Description
CD4511BCWM	M16B	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
CD4511BCN	N16E	16-Lead Plastic Dual-In-Line Package (PDP), JEDEC MS-001, 0.300" Wide

Devices also available in Tape and Reel. Specify by appending suffix letter 'X' to the ordering code.

Connection Diagrams

Pin Assignments for SOIC and DIP



Top View

Segment Identification

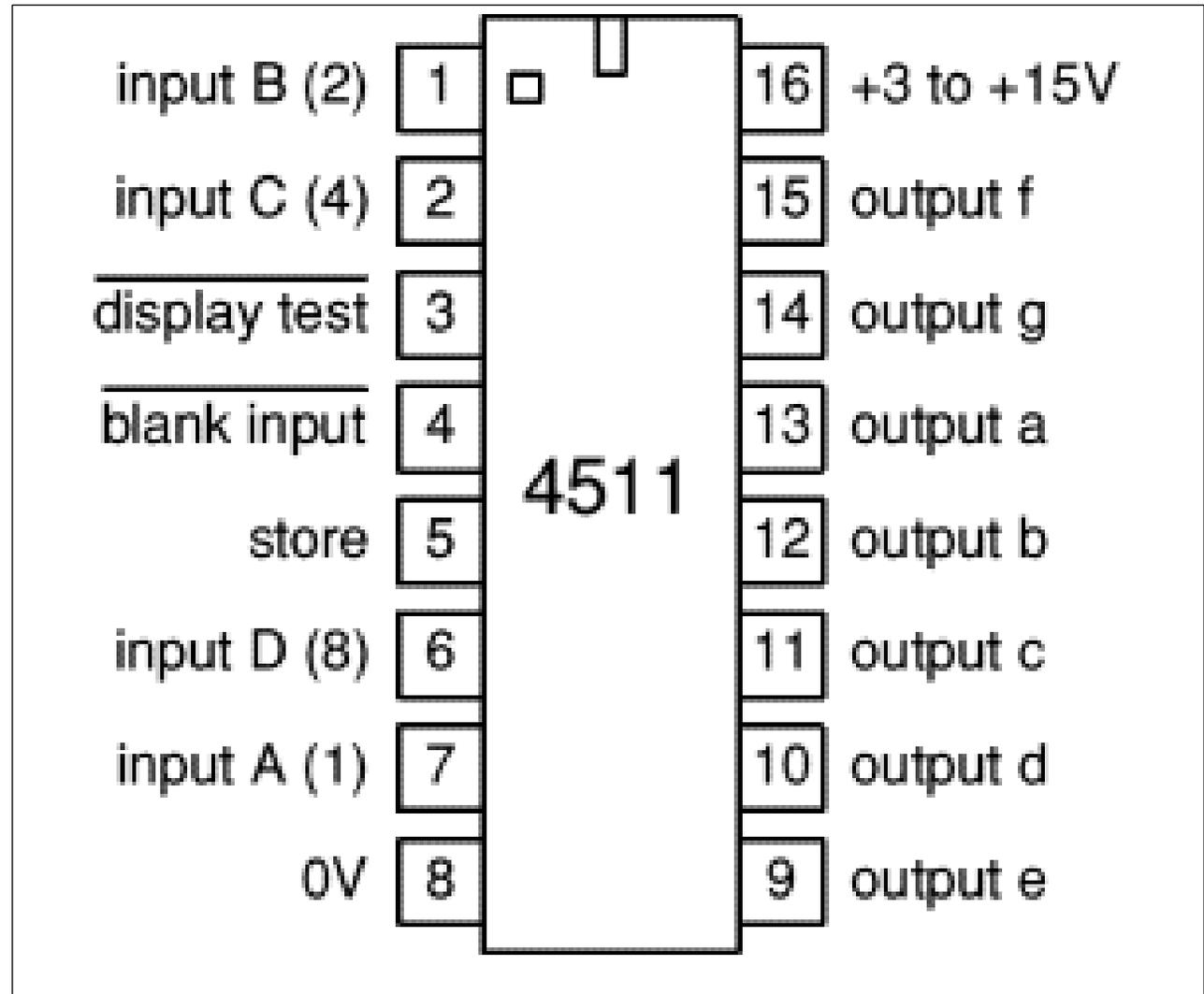


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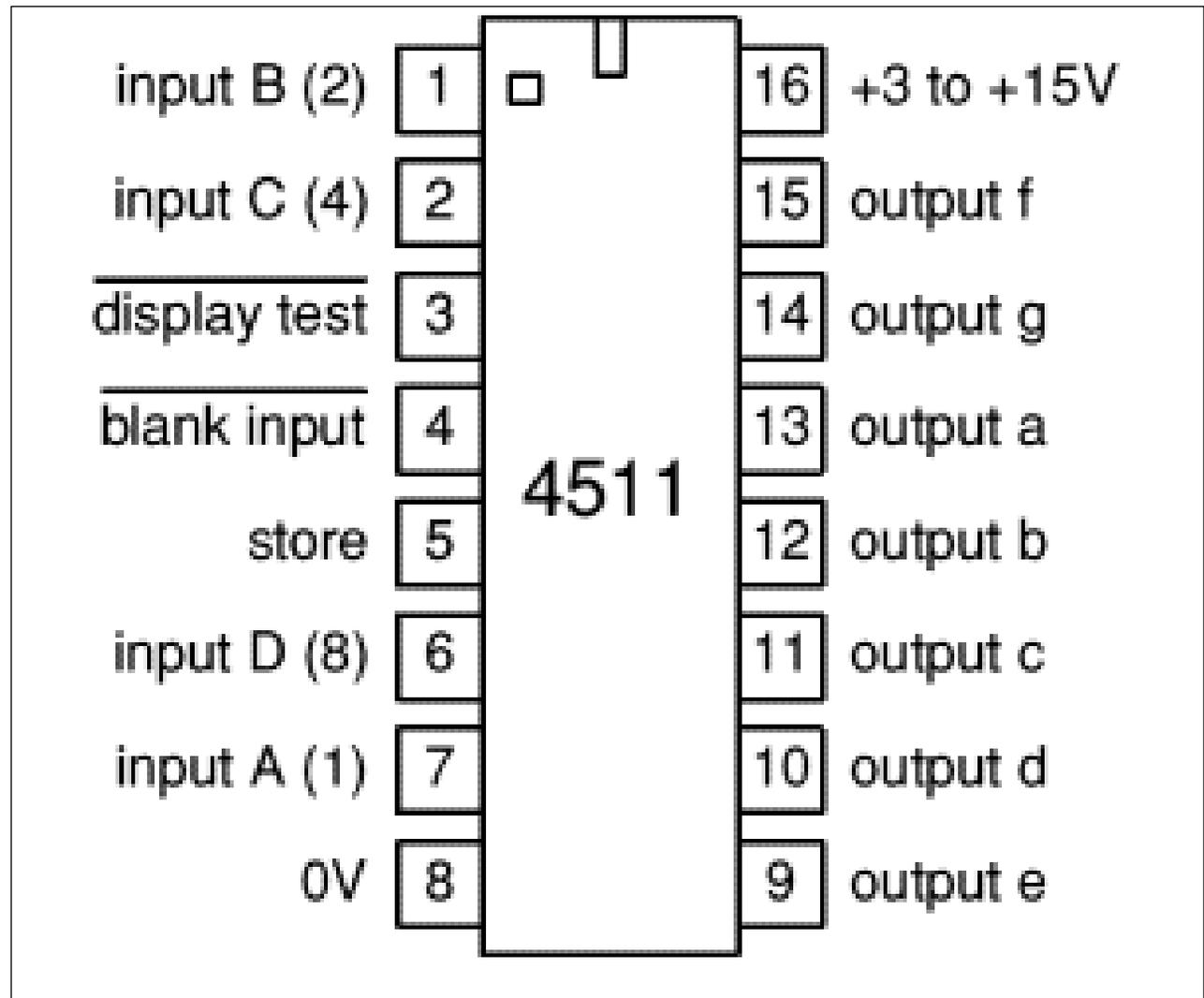
pinout and electronic

1. Use a 4511 CMOS Latch/Decoder Driver. With the power supply OFF, connect pin 16 to +5 and pin 8 to ground (they call these pins Vdd and Vss respectively).
2. Connect pin 3 and 4 (/LT and /BI) high (i.e. to +5). Connect pin 5 (LE) low (i.e. to ground).
3. Connect all the small letters a to g (pins 9-15 on the 4511) to the free end of their corresponding 470 ohm current limiting resistor on the MAN-74 display.
4. Temporarily connect the large letters A to D (pins 1, 2, 6, and 7) to ground.
5. Apply power. The display should show you the value zero (0).
6. Connect pin 7 (A) high. The display should switch to a 1.
7. Reconnect pin 7 low and connect pin 1 (B) high. The display should show a 2.



CONTINUED ON THE NEXT PAGE

8. Leave pin 1 high and reconnect pin 7 high. The display should show a 3.
9. Take both pins 1 and 7 low. Connect pin 2 (C) high. The display should show a 4.
10. Now I'd like you to use your knowledge of binary arithmetic. If I tell you that the four binary digits that correspond to 1, 2, 4, and 8 are A, B, C, and D respectively, can you make the digits show 5, 6, 7, 8, and 9 yourself?
11. This is called "BCD" arithmetic. BCD stands for Binary Coded Decimal. Somehow there has to be an interface between machine calculations and human beings and BCD is the way it is done.
12. What is the largest number that can exist in a 4-digit binary code in the BCD system.? Can there be a single digit greater than 9 in the decimal system? What happens to the display if you try and input a number greater than binary 9? Say, 1101 (binary 13). What does the display do?
13. Remove the grounds from the A, B, C, and D inputs.



Now let's make a real counter out of it with a 4029 decimal counter:

(See last page for a mod to the trainer clock for these last steps.)



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October 1987
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CD4029BC Presettable Binary/Decade Up/Down Counter

General Description

The CD4029BC is a presettable up/down counter which counts in either binary or decade mode depending on the voltage level applied at binary/decade input. When binary/decade is at logical "1", the counter counts in binary, otherwise it counts in decade. Similarly, the counter counts up when the up/down input is at logical "1" and vice versa.

A logical "1" preset enable signal allows information at the "jam" inputs to preset the counter to any state asynchronously with the clock. The counter is advanced one count at the positive-going edge of the clock if the carry in and preset enable inputs are at logical "0". Advancement is inhibited when either or both of these two inputs is at logical "1". The carry out signal is normally at logical "1" state and goes to logical "0" state when the counter reaches its

maximum count in the "up" mode or the minimum count in the "down" mode provided the carry input is at logical "0" state.

All inputs are protected against static discharge by diode clamps to both V_{DD} and V_{SS} .

Features

- Wide supply voltage range: 3V to 15V
- High noise immunity: 0.45 V_{DD} (typ.)
- Low power TTL compatibility: fan out of 2 driving 74L or 1 driving 74LS
- Parallel jam inputs
- Binary or BCD decade up/down counting

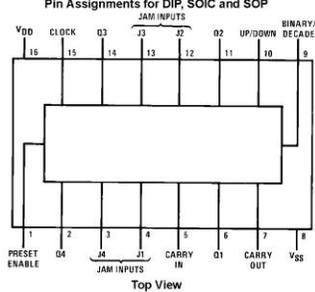
Ordering Code:

Order Number	Package Number	Package Description
CD4029BCWM	M16B	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide body
CD4029BCSJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
CD4029BCN	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

Devices also available in Tape and Reel. Specify by appending the suffix letter 'X' to the ordering code.

Connection Diagram

Pin Assignments for DIP, SOIC and SOP



Top View

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CD4029BC Presettable Binary/Decade Up/Down Counter

1. This is a fairly good view of the 4029 counter chip. Let's examine some of the pins and how to connect them as a counter.

2. Outputs QA (6), QB (11), QC (14) and QD (2) should go to the digits driver chip 4511 pins 7 (A), 1 (B), 2 (C), and 6(D) respectively.

3. All inputs Preset (1), Input D (3), Input A (4), Carry In (5), Decade (9), Input B (12), Input C (13) should go to ground (zero volts, low).

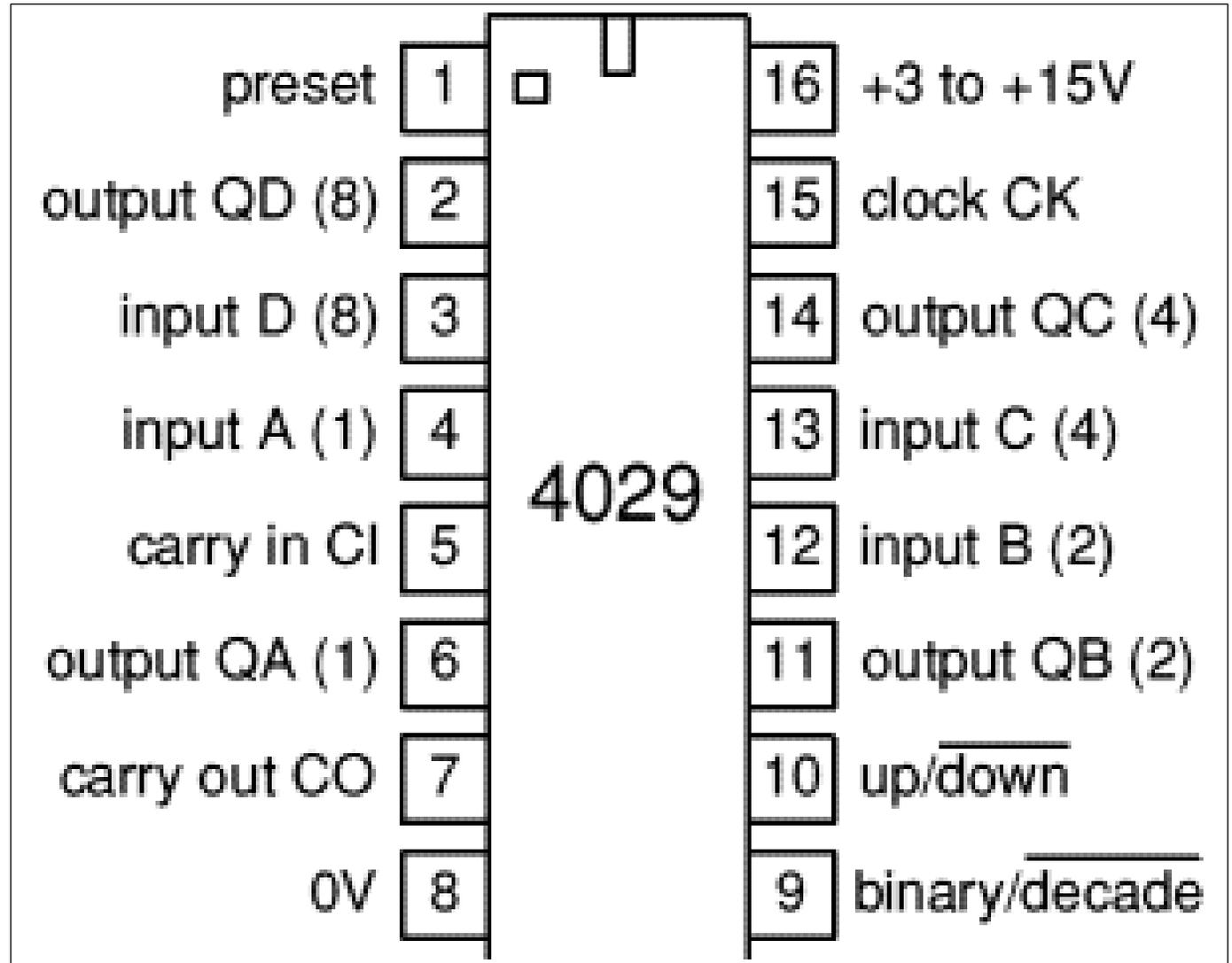
4. +5 supply to Up/Down (10) and V_{dd} (16).

5. Ground to 0V (pin 8)

6. Clock to the TTL output of the function generator on the trainer. Set the function generator for one square wave per second. (1 Hz).

7. When the trainer is powered up, the digits should count from zero to 9, back to zero again, up to 9, in a continuous loop.

8. Now reverse the counter from an UP counter to a DOWN counter. Take pin 10 high (+5 volts). Now the counter should count DOWN from 9 to 0 continuously repeating.



CONTINUED ON THE NEXT PAGE

9. You don't have to do anything with this step, just for your information. Inputs A, B, C, and D are what are called "jam" inputs. Whatever number is programmed into these inputs will appear at the outputs QA-QD when the PRESET is taken high. Thus, you can program in at what number you want to start counting.

An extra special just because it is getting close to the end of the semester offer.

Make an exact duplicate of the circuit you have already made and connect pin 7 (Carry Out) of the first circuit you made to pin 5 (Carry In) of the duplicate.

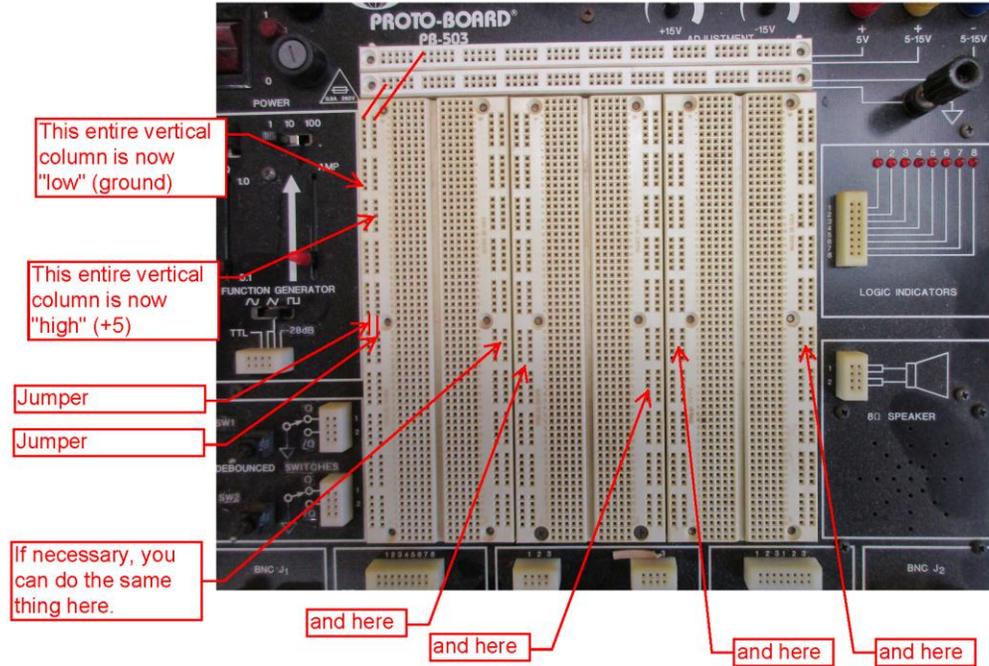
Show me that you can count 0-99 and get **50**** bonus points for the semester.**

Show me that you can count 99-0 and get **50**** more bonus points for the semester.**

(Pin 15 of both chips should be connected to the clock TTL input.)

LAB AID

In the digital world, there are a great number of connections to and from ground and the + supply. Sometimes this gets to be a "rat's nest" of wires. It helps a great deal to use the side vertical connectors to bring ground ("low") and the + supply ("high") to make the connections easier.



The new trainers have a "glitch" in the TTL output of the function generator. To get around this glitch, use this circuit whenever you need a "clock" pulse(s) from the TTL output.

