~Dashboard Digital Voltmeter~

This project is helpful to anyone who drives an automobile. I had found this project at the local libary... in an old publication. I made it and it worked fine.

Below are the complete text and schematic of the Dashboard Digital Voltmeter. I re-typed the text and re-drew the schematic...as the printing from the book was old and faded. Sit back and read the story why this LED display might just save you from being stranded on the road!

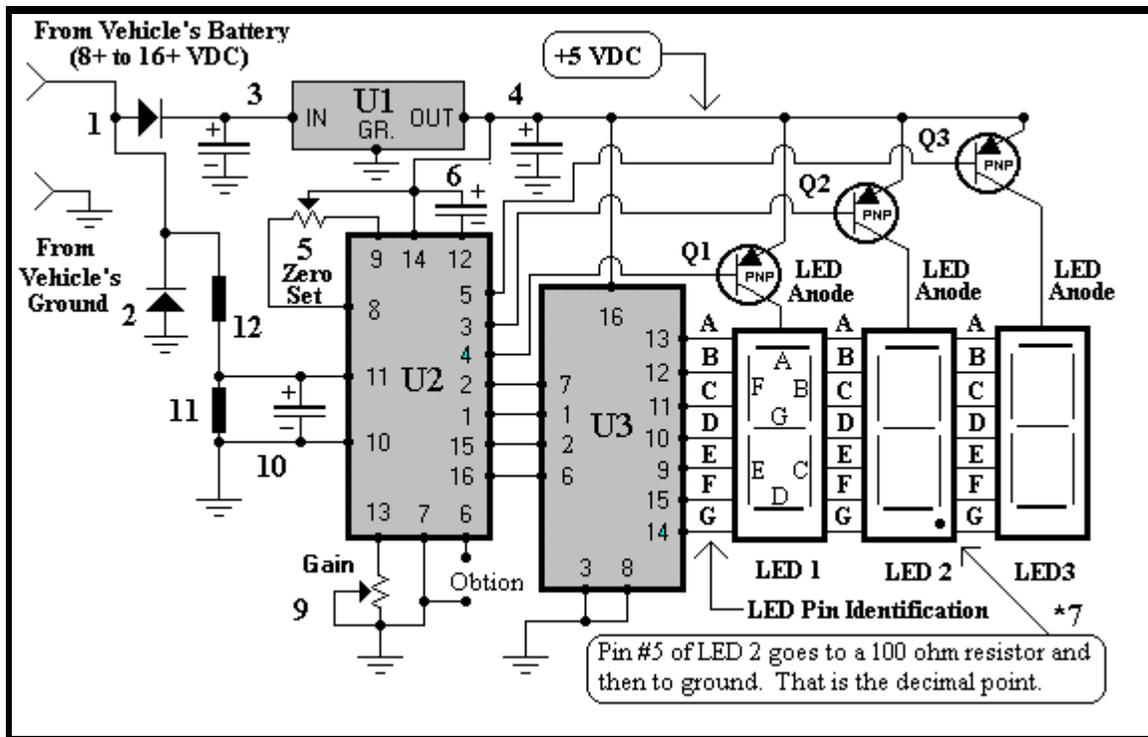
Dashboard Digital Voltmeter

Your making time down the interstate at three in the morning...all of a sudden you become aware that the lights on the dash seem kind of dim, and that the headlights don't seem to be reaching out as far ahead to warn you of darkened 18-wheelers' parked on the shoulder. Are your eyes just playing tricks on you, or is there something the matter with your car's electrical system? A quick glance down at the three glowing LED numerals on the dash gives your the instant answer. Either you pull into a rest area and grab a few hours of shuteye, or you pull into a service area and have the *battery, alternator* and *voltage regulator* given a good scrutinizing by the mechanic.

In either case, your car's digital voltmeter has given you the information that was needed about the car's electrical system; and maybe saved you either a headache, a smashup, or a king-sized repair and towing bill. Maybe all three...

Recent advances in the design and availability of industrial integrated circuits have opened up many doors to the electronic hobbyist. Analog-to-digital devices have become more complex internally, thus making the portions of the circuitry that have to be assembled by the hobbyist that much more simple. The Dashboard Digital Voltmeter takes advantage of these advances, utilizing three IC's and a small handful of discrete components to give you an instrument capable of better than +/- 1% accuracy in reading the voltage level delivered by your vehical's (car/boat/motorcycle) electrical system.

If this project has interest to you...we shall begin!


The Dashboard Digital Voltmeter Schematic

# Parts List for the Dashboard Digital Voltmeter

1. 1N4002 Diode	11. 1K ohm resistor (1/4 watt)
2. 1N4002 Diode	12. 100K ohm resistor (1/4 watt)
3. 47uF/25v (Electrolytic capacitor)	U1 LM340-T-5 (5vdc voltage regulator)
4. 10uF/16v (Tantalum capacitor)	U2 NTE2054 or CA3162E (Analog to Digital Converter)
5. 50K Potentiometer	U3 NTE2032 or CA3161E (BCD Display Driver)

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6. .33uF /35v (Tantalum capacitor)	Q1, Q2, Q3 PNP - 2N2907 or MPS2907 (3 are needed)
*7. LED #2 has the decimal point lite.	LED - NTE3078 or ECG3078 Common Anode (3 are needed)
8. Omitted	IC Sockets - For the LED's and IC's.
9. 10K Potentiometer	
10. 10uF/16v (Tantalum capacitor)	

The PCB
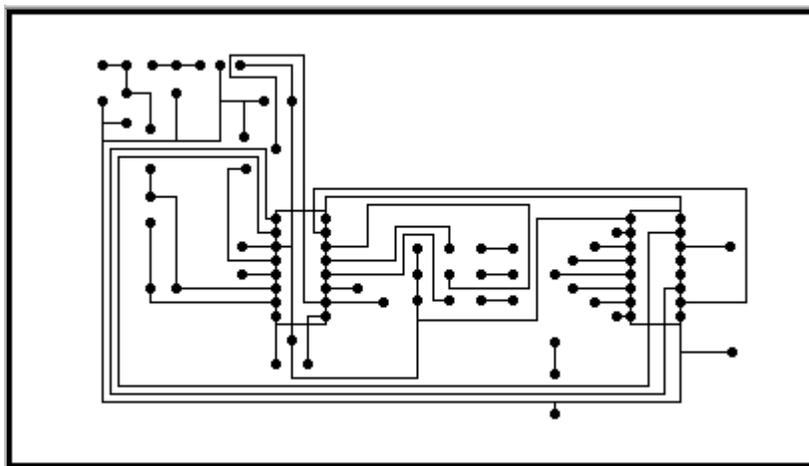
Placement of Components on the PCB
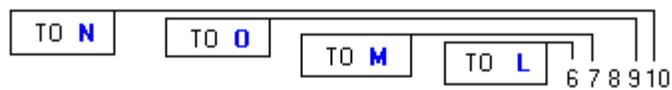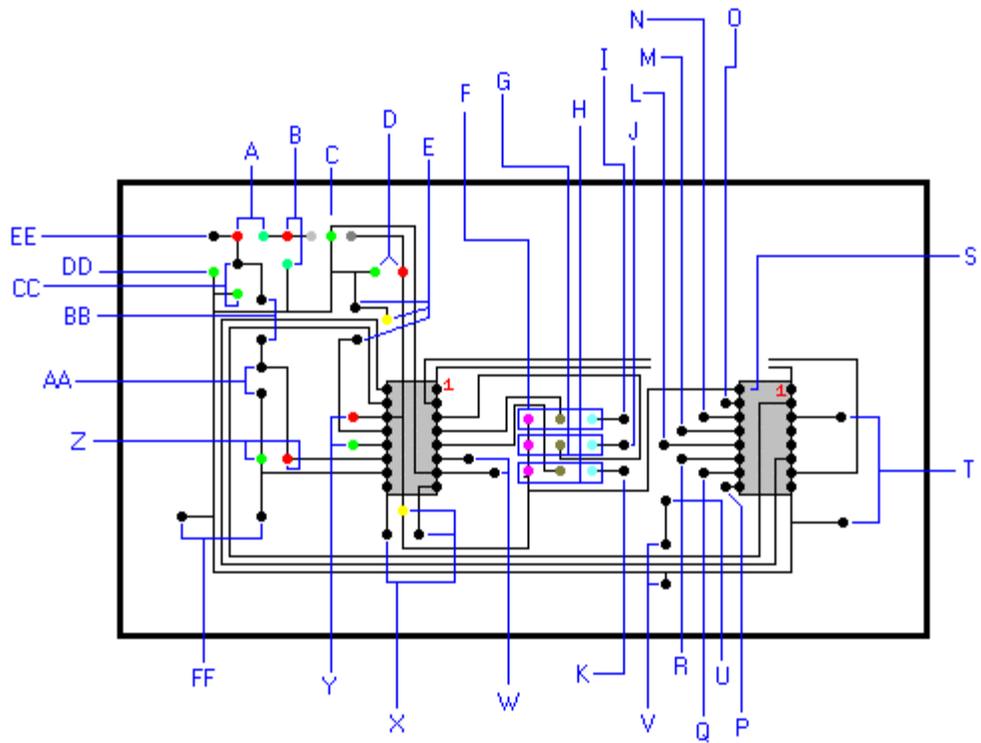
ALL THREE LED'S GO TO THE
SAME DESIGNATED LETTERING,
EXCEPT WHERE NOTED.

TO N
TO O
TO M
TO L

6 7 8 9 10

1 2 3 4 5

TO Q
TO P
TO R
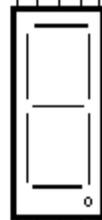
LED #1, PIN 3, GOES TO I
LED #2, PIN 3, GOES TO J
LED #3, PIN 3, GOES TO K

LED #2, PIN 5,
GOES TO U

Identification of Lettering With Respect to Components

A. 1N4002 Diode (Observe Polarity)	Q. Terminal connection for 'G' of LED #1, #2, #3
B. 47uF/25v Electrolytic Capacitor (Observe Polarity)	R. Terminal connection for 'F' of LED #1, #2, #3
C. LM340T-5 Voltage Regulator	S. This is the +5v line coming from the Voltage Regulator.
D. 10uF/16v Tantalum Capacitor (Observe Polarity)	T. This is where a 'cross-over' wire needs to be put. It must be put on the opposite side of the copper routing, in order for it not to interfere with the copper routing coming in to Pin #7 of the CA3161E.
E. 10K Potentiometer (The Yellow terminal is for the center leg on the potentiometer)	U. Terminal connection for the 'decimal point' on LED #2.
F. 2N2907 1st Transistor - Purple (E) Brown (B) Lt. Blue (C)	V. 100 ohm resistor, 1/4 watt
G. 2N2907 2nd Transistor - Purple (E) Brown (B) Lt. Blue (C)	W.
H. 2N2907 3rd Transistor - Purple (E) Brown (B) Lt. Blue (C)	X. 50K ohm Potentiometer (The Yellow terminal is for the center leg on the potentiometer)
I. Terminal connection for Anode of LED #1	Y. .33uF/35v Tantalum Capacitor (Observe Polarity)
J. Terminal connection for Anode of LED #2	Z. 10uF/16v Tantalum Capacitor (Observe Polarity)
K. Terminal connection for Anode of LED #3	AA. 1K Resistor, 1/4 Watt
L. Terminal connection for 'E' of LED #1, #2, #3	BB. 100K Resistor, 1/4 Watt
M. Terminal connection for 'D' of LED #1, #2 #3	CC. 1N4002 Diode (Observe Polarity)

N. Terminal connection for 'C' of LED #1, #2, #3	DD. INPUT - From automobile battery (-) side
O. Terminal connection for 'B' of LED #1, #2, #3	EE. INPUT - From automobile battery (+) side
P. Terminal connection for 'A' of LED #1, #2, #3...	FF. This is where another 'cross-over' wire needs to be put. It must be put on the opposite side of the copper routing, in order for it not to interfere with the copper routing coming from Pin #2, Pin #6 and Pin #8 of the CA3161E.

Finding The Parts To Begin The Project

Mouser Electronics (toll free 1-800-346-6873) here in the USA does carry the LED's and IC's as well as insert sockets..and the rest of the components for the project. Your local Radio Shack store would carry the more common items, such as... resistors, capacitors, diodes, voltage regulator and transistors. Also insert sockets for the LED's and IC's.

Let us begin...

The ICs

The system is built around three ICs: the LM340T-5 (a 5-volt regulator); a NTE2054; a NTE2032; and a support combination of diodes, resistors and capacitors. It is the NTE2032 and NTE2054 that is at the heart of the system.

Circuit Function

Analog voltage from 000 mV's to 999 mV's can be applied between pins 11 (+) and 10 (-) of the CA3162E (U2). That IC converts the voltage into a Binary Coded Decimal (BCD) equivalent. The BCD leaves pins 2, 1, 15 and 16 (the group represents the 1's, 2's, 4's, and 8's) and enters pins 7, 1, 2 and 6 respecitvely of the CA3161E (U3). The latter IC takes the BCD code, converts the output, then uses it

(in conjunction with the 7-segment display) to generate (form) the number that correlates to the BCD input of the CA3161E. The multiplexing driver pins 5, 3 and 4 (5 being the least significant and 4 the most significant) turn on that display by means of the PNP switching transistors (Q1, Q2 and Q3). Concurrently, the CA3162E is providing the BCD information to the CA3161E driver/decoder.

The maximum input differential between pins 11 and 10 of the CA3162E is 999 mV's. A resistor network (R1, R2) is used to attenuate the applied 13.8 volts to 138 mV's. An Ohm's Law calculation would give a result of 136.6 mV's. The gain-adjust potentiometer compensates for the slight drop. The The three LED's display this as 13.8 volts.

Note the point marked "Obtion" in the schematic. With Pin 6 of the CA3162E grounded or disconnected, there are four conversions or comparisons made each second. Tying pin 6 to the 5-volt line will result in 96 conversions or comparisons per second. The 96/second rate moves with excessive rapidity and is not appealing to the eye, and usually results in the least significant digit appearing to be blurred. Of the two rates, the 4/second conversion (4 Hz) is by far the more pleasing to the eye, is easier for the eye to focus on quickly, and is the recommended rate.

Assembling the Voltmeter

Do as you would any other project by soldering all of the components on the board once the PCB has been made. There is no right way of routing the electrical circuitry. Any route you may choose to use should be OK.

Hooking it up and Calibration

Before accurate calibration can be done, you need to have a functional DVM on hand to check the exact voltage of the battery (with engine off) in relation to calibrating your Dashboard Digital Voltmeter. Let's assume that your battery was checked with a DVM and gave a reading of 13.8vdc. Now you may proceed to the calibration of the Dashboard Digital Voltmeter.

Correct calibration determines the accuracy of your Dashboard Digital Voltmeter. Follow these steps carefully and sequentially. First, connect the inputs of the Dashboard Digital Voltmeter straight to the battery. Next, for zero adjustment, ground pins 11 and 10 to the circuit board ground momentarily. Using a small screwdriver, slowly rotate the wiper arm on R3 until there is a reading of 000. Now remove the ground from pins 10 and 11. Set the gain control (R4) by rotating the wiper arm until the displays are displaying 13.8 .... which should be the same voltage as is being applied. Now you have calibrated it and are ready to mount the project somewhere you can visually see the LED's at all times.