TITLE: BAR GRAPH DRIVER AND DISPLAY CIRCUITS

OBJECT: The purpose of the experiment is to observe the application of operational amplifier comparator circuits on bar graph display drivers.

EQUIPMENT: LM324 QUAD OPAMP integrated circuit, DMM, resistors, 1N914 (1N4148) diode, 1N751A zener diode, red, green and yellow light emitting diodes (LED).

PROCEDURE:

1. 4 SEGMENT BAR GRAPH DRIVER AND DISPLAY LAYOUT

1.1 Set up the circuit in Figure 1 for the 4 SEGMENT BAR GRAPH DRIVER AND DISPLAY. It is very important to use excellent breadboarding techniques, not only for appearance, but for troubleshooting in case of difficulty in obtaining proper operation. Use short as possible wires to make connections on the breadboard. DO NOT have any arching wire connections. All wiring should be neatly routed and flush to the breadboard surface. AVOID having wires or components passing over the integrated circuit(s) in case it has to be removed.

1.2 Be sure to identify and know the location of VREF, VREFC, TP1, TP2, TP3, VIN, +Vs and GND. DO NOT make any power supply connections.

1.3 Have your instructor approve breadboard layout.

2. BASIC 4 SEGMENT DISPLAY CIRCUIT

2.1 Set up the circuit shown in Figure 2. Be sure the negative terminals of the power supply are tied together and connected to circuit ground.

2.2 With Vin set near zero volts (knob fully counter clockwise), adjust +Vs to 15 VDC and +VREF to 12 VDC.

2.3 Measure and record the DC voltages at +VREF, TP1, TP2 and TP3. Calculate the voltages at TP1, TP2 and TP3 using the measured value of +VREF.

2.4 Adjust Vin until the green LED just emits light. This should occur at about 3 volts. Measure and record the value of Vin for the green LED to just light. Measure and record the differential voltage (VDIFF) at <u>each</u> OPAMP input for the green LED to just light. To get the correct polarity of VDIFF place the (+) lead (red) of the DVM at the plus input of the OPAMP and the (-) lead (black) of the DVM at the minus input of the OPAMP.

2. (Continued)

2.5 Reduce Vin until the green LED just stops emitting light. Measure and record the VDIFF at <u>each</u> OPAMP input for the green LED to just stop emitting light.

2.6 Repeat PROCEDURE steps 2.4 and 2.5 for the remaining LEDs for Vin near 6, 9 and 12 volts. Reduce Vin to near zero volts, knob fully counter clockwise.

3. ZENER DIODE REFERENCE SOURCE - ONE POWER SUPPLY

3.1 Remove the 12 volt power supply and modify the test circuit to that shown in Figure 3.

3.2 With Vin set to near zero volts (knob fully counter clockwise), adjust Vs to 15 VDC.

3.3 Measure and record the DC voltage at +VREF, TP1, TP2 and TP3. Calculate the voltages at TP1, TP2, and TP3 using the measured value of +VREF.

3.4 Adjust Vin until the green LED just emits light. This should occur at about the same voltage as measured at TP3 in step 3.3. Measure and record Vin.

3.5 Increase Vin until the next LED (yellow) just emits light. This should occur at about the same voltage as measured at TP2 in step 3.3. Measure and record Vin.

3.6 Repeat step 3.5 for the third and fourth LED. Measure and record Vin for each case. Compare Vin with the voltage at TP1 and +VREF. Reduce Vin to near zero. Knob fully CCW.

4. EXPANDED DISPLAY (8 SEGMENT, 0-5 VOLTS)

4.1 Construct the expanded 8 SEGMENT BAR GRAPH DISPLAY as shown in Figure 4.

4.2 With Vin set to near zero volts (knob fully CCW), adjust +Vs to 15 VDC.

4.3 Measure and record the DC voltage at +VREF, TP1, TP2, TP3 (at BAR GRAPH #2) and +VREF, TP1, TP2, and TP3 (at BAR GRAPH #1). Calculate the voltages at TP1, TP2, TP3 (BARGRAPH #2) and TP1, +VREF, TP2, TP3 (BAR GRAPH #1) using the measured value of +VREF of BAR GRAPH #2.

4.4 Adjust Vin until the green LED (BAR GRAPH #1) just emits light. This should occur at about the same voltage as measured at TP3 (BAR GRAPH #1) in step 4.3. Measure and record Vin.

4. (Continued)

4.5 Repeat step 4.4 for the remaining 7 LEDs. Measure and record Vin for each case. Compare Vin with the respective test point voltages at the bar graph voltage divider. Reduce Vin to near zero, knob fully CCW.

5. EXPANDED DISPLAY (8 SEGMENT, 0-12 VOLTS)

5.1 Repeat PROCEDURE 4, for the 8 SEGMENT BAR GRAPH DISPLAY as shown in Figure 5.

ELECTRONIC CIRCUITS 4 SEGMENT BAR GRAPH DRIVER AND DISPLAY

1. BASIC 4 SEGMENT BAR GRAPH CIRCUIT

NOTE:
1) R1=R2=R3=R4= 768 OHMS
2) R7=R8=R9=R10= 768 OHMS
3) R6=10 TO 20K, USE 14.3K
4) VS= 15V, +VREF < VS
5) +VREFC < VS
6) VIN < VS

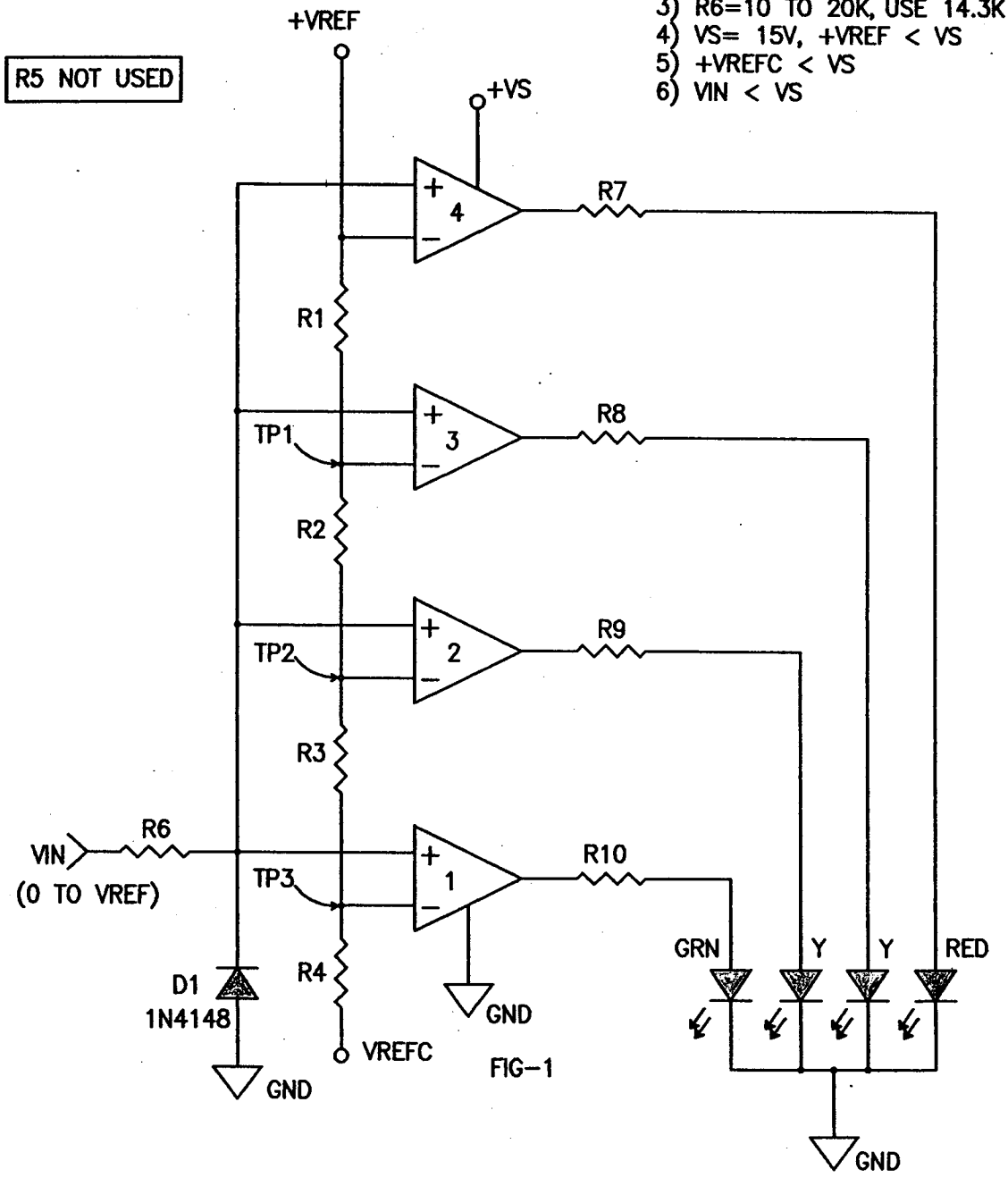
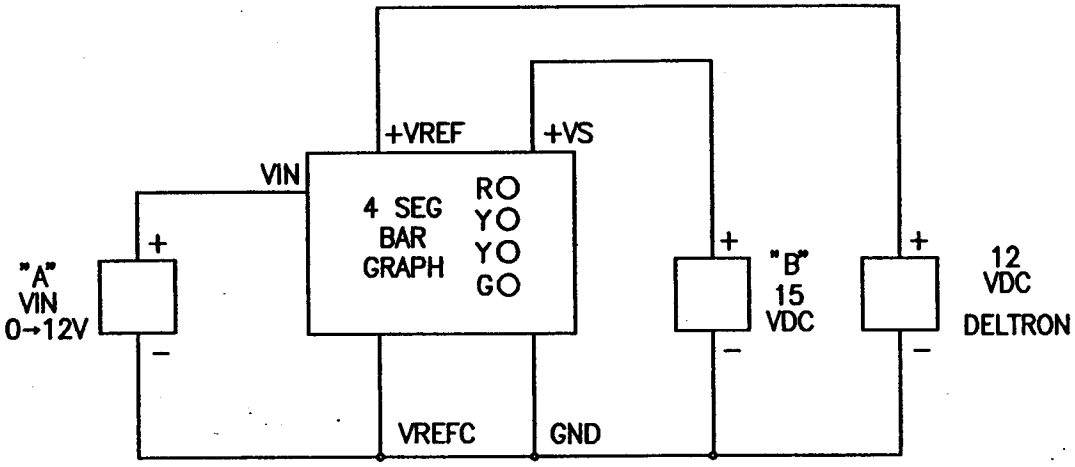


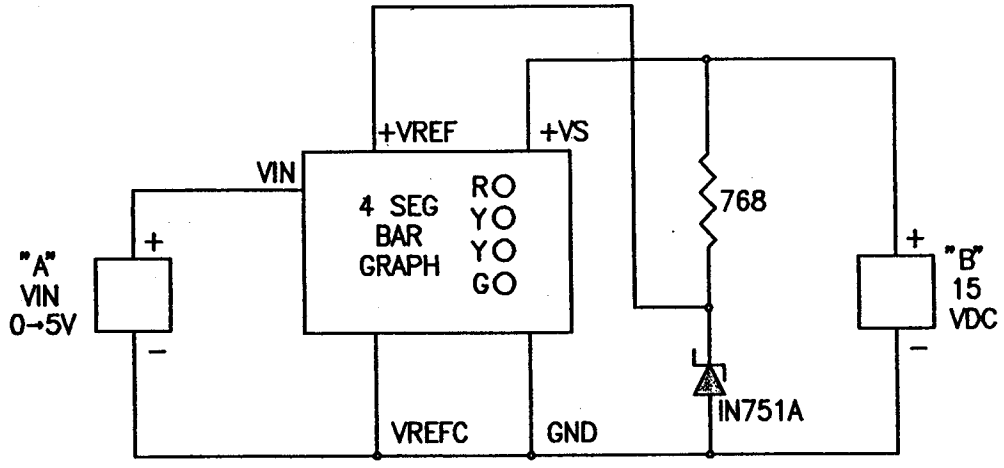
FIG-1

2. BASIC 4 SEGMENT TEST CIRCUIT



LEDS LITE AT VIN= 3V, 6V, 9V, 12V AND STAY LIT

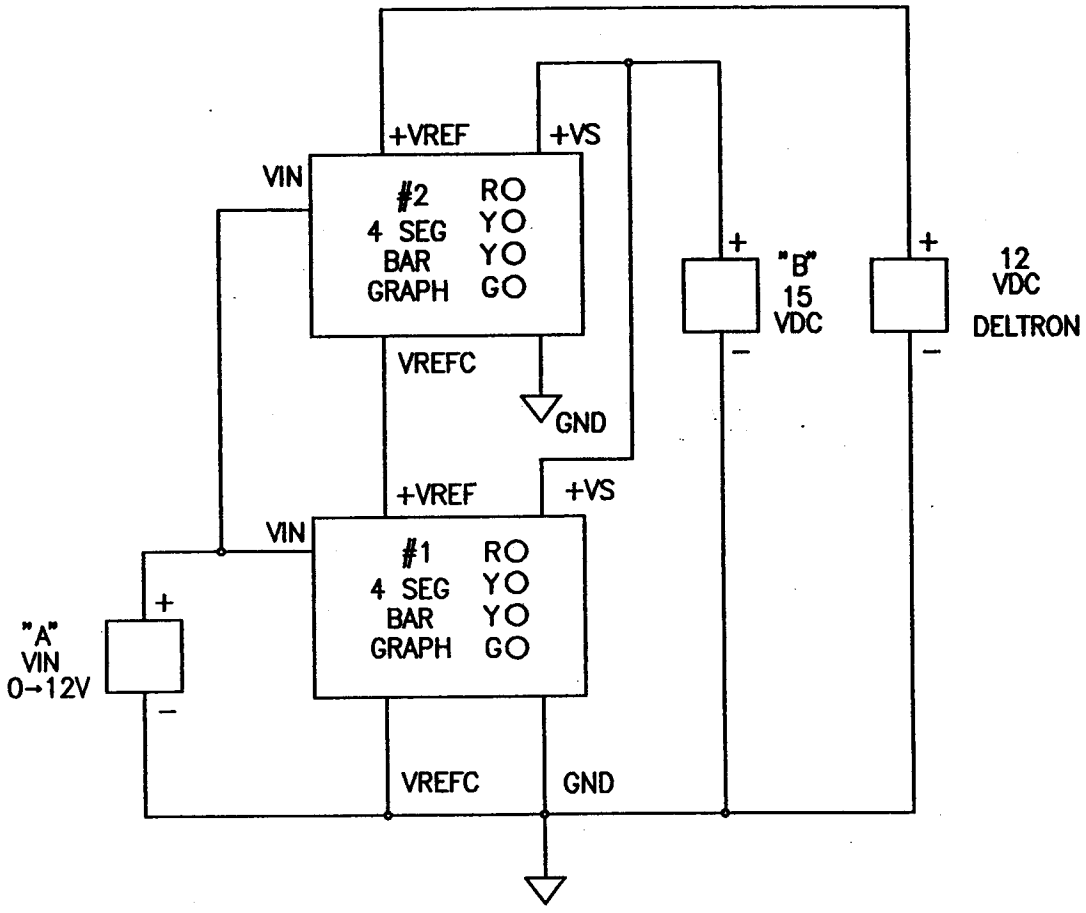
3. EXTERNAL REFERENCE FROM ZENER DIODE – ONE POWER SUPPLY



FIG–3

LEDS LITE AT VIN= 1.25, 2.5, 3.75, 5V AND STAY LIT

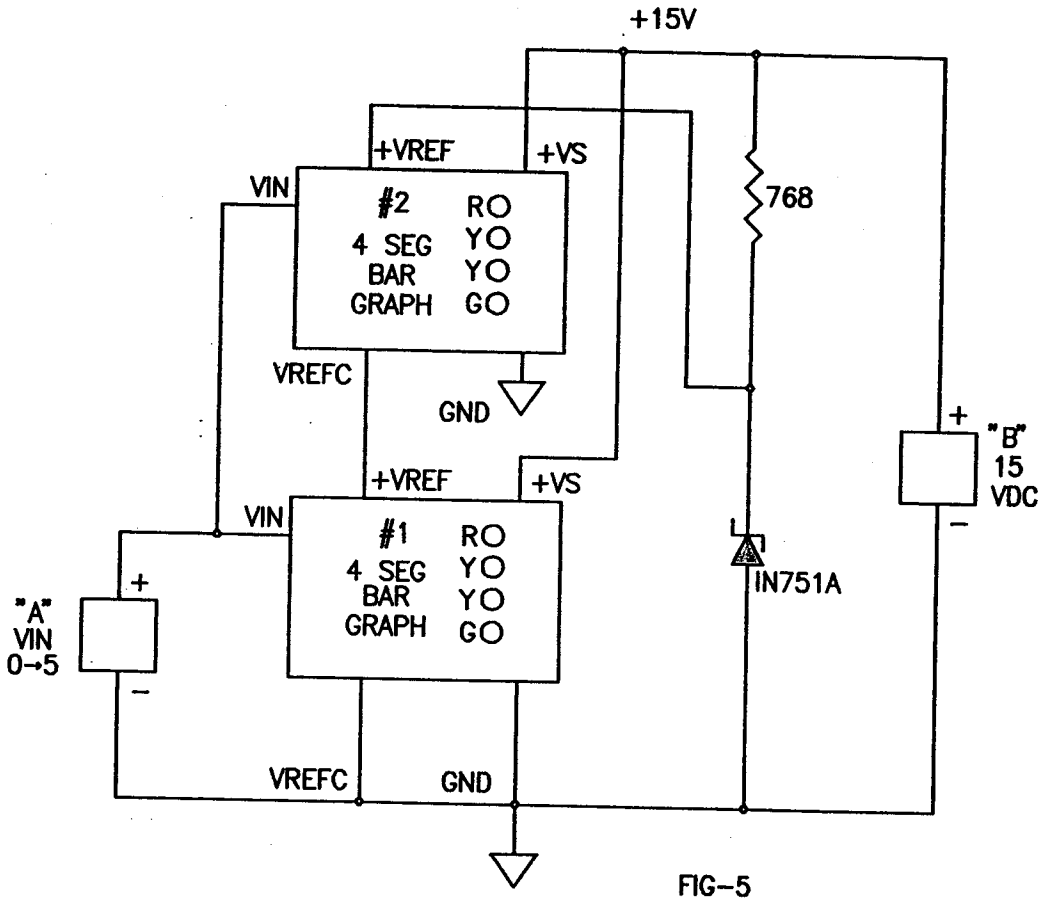
4. EXPANDED DISPLAY (8 SEGMENT)



LEDS LITE AT: 1.5V, 3V, 4.5V, 6V, 7.5V, 9V, 10.5V, 12V

#1 #2

5. EXPANDED DISPLAY (8 SEGMENT) 0 TO 5 VOLTS



FIG–5

LEDS LITE AT: .625V, 1.25V, 1.875V, 2.5V, 3.125V, 3.75V, 4.375V, 5V

#1 #2