DIGITAL LED THERMOMETER

ANALOG ELECTRONIC CIRCUITS J - COMPONENT

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➢ ABSTRACT:

- The circuit given here is a precision LED thermometer, which can be used as a temperature measurement circuit, build around IC LM 34 (sensor) and IC LM 3914 (bar graph driver).
- To calibrate the circuit, you will need a voltmeter.
- Power the circuit. Ground the negative lead of the voltmeter and connect the positive lead to pins 6 and 7 of IC LM 3914.
- Adjust R7 so the meter reads 3.345V as possible.

➢ ABSTRACT:

- Now connect the positive lead of the meter to pin 4 of IC LM 3914 and change R5 until the meter reads 2.545V.
- Disconnect power to the circuit and remove both IC's from their holders. Check the value of R3 with an ohmmeter and remember that value.
- Connect the ohmmeter across R1 and set R1 to a value of exactly 3 times the value of R3. Reconnect both IC's and the circuit is ready.

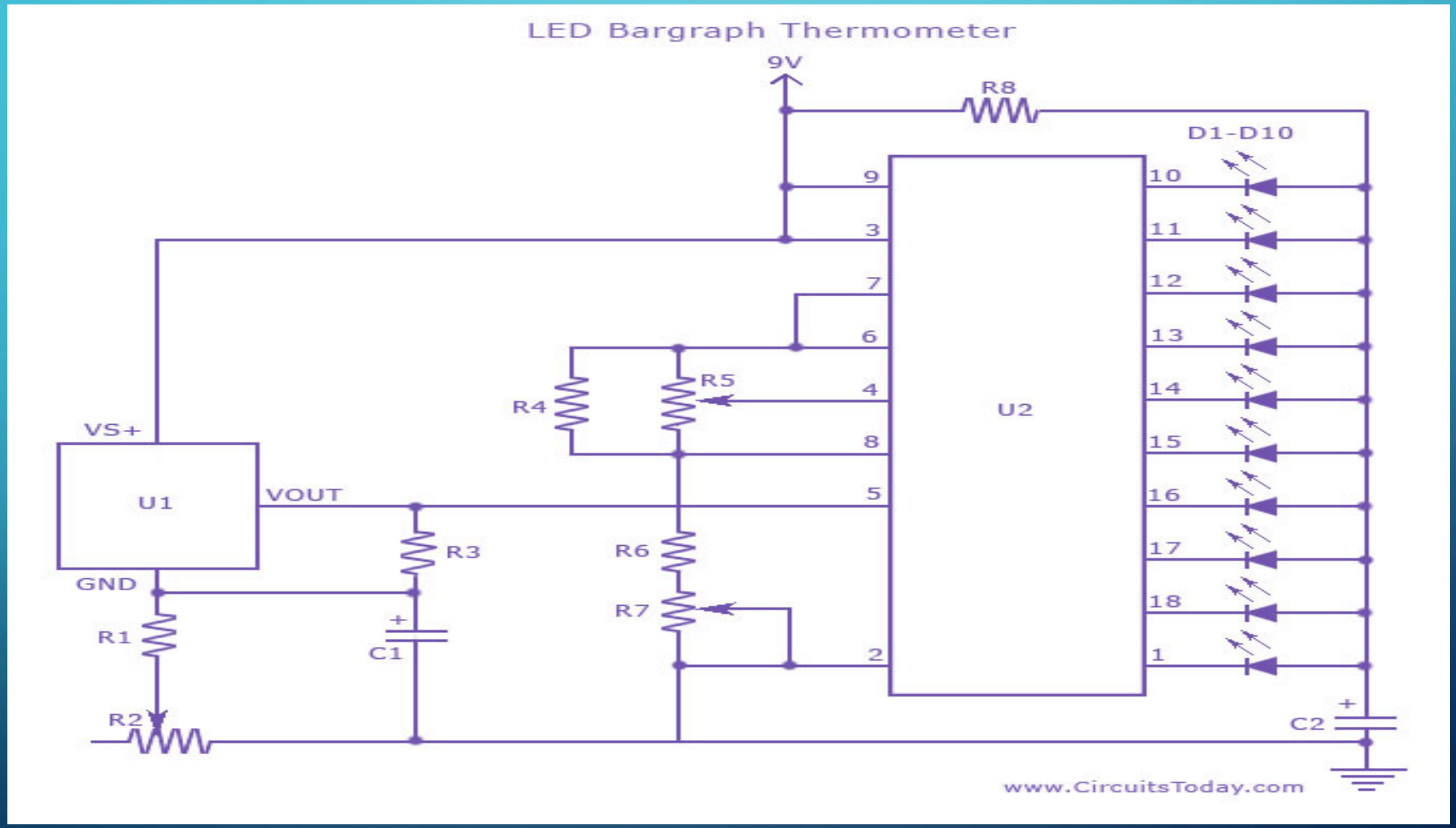
➢ COMPONENTS USED

- Major Parts are

1) LM3914 IC
2) LM35 Temperature Module
3) Other parts are shown aside.

Label	Description
R1	2.2K ohm 1% 1/4W Metal Film Resistor
R2	1K ohm 1% 1/4W Metal Film Resistor
R3	1.5K ohm 1% 1/4W Metal Film Resistor
R4	470 ohm 1% 1/4W Metal Film Resistor
R5	15 ohm 1% 1/4W Metal Film Resistor
VR1, VR2, VR3	1K ohm Potentiometer
S	SPST switch
E1	1uF/25V Electrolytic Capacitor
E2	22uF/25V Electrolytic Capacitor
U1 IC	LM3914
U2	LM34
JP	Jumper and Header
L1-L10	Light emitting diodes 5mm or 3mm
VCC	9V Battery and Holder

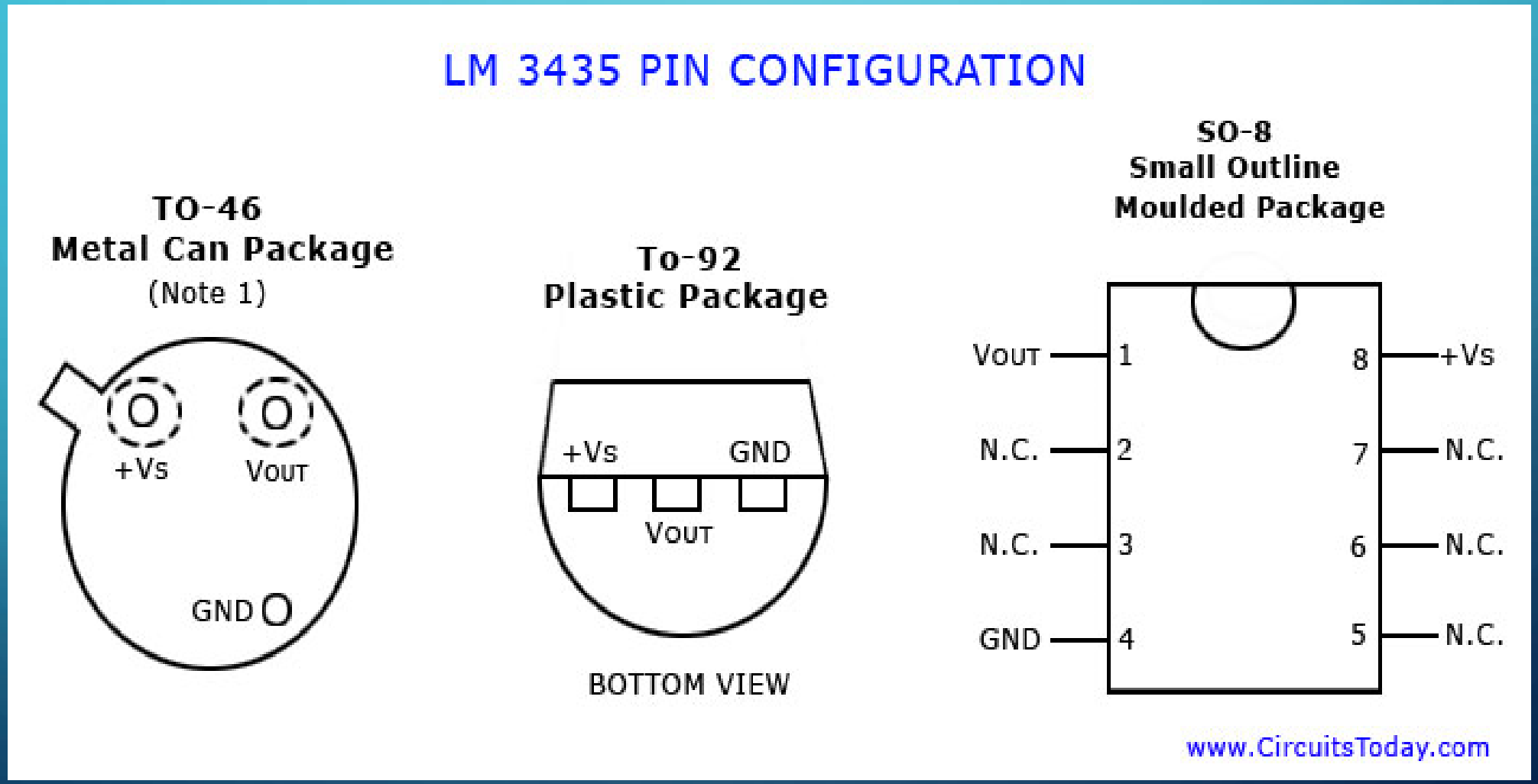
➢ CIRCUIT DIAGRAM



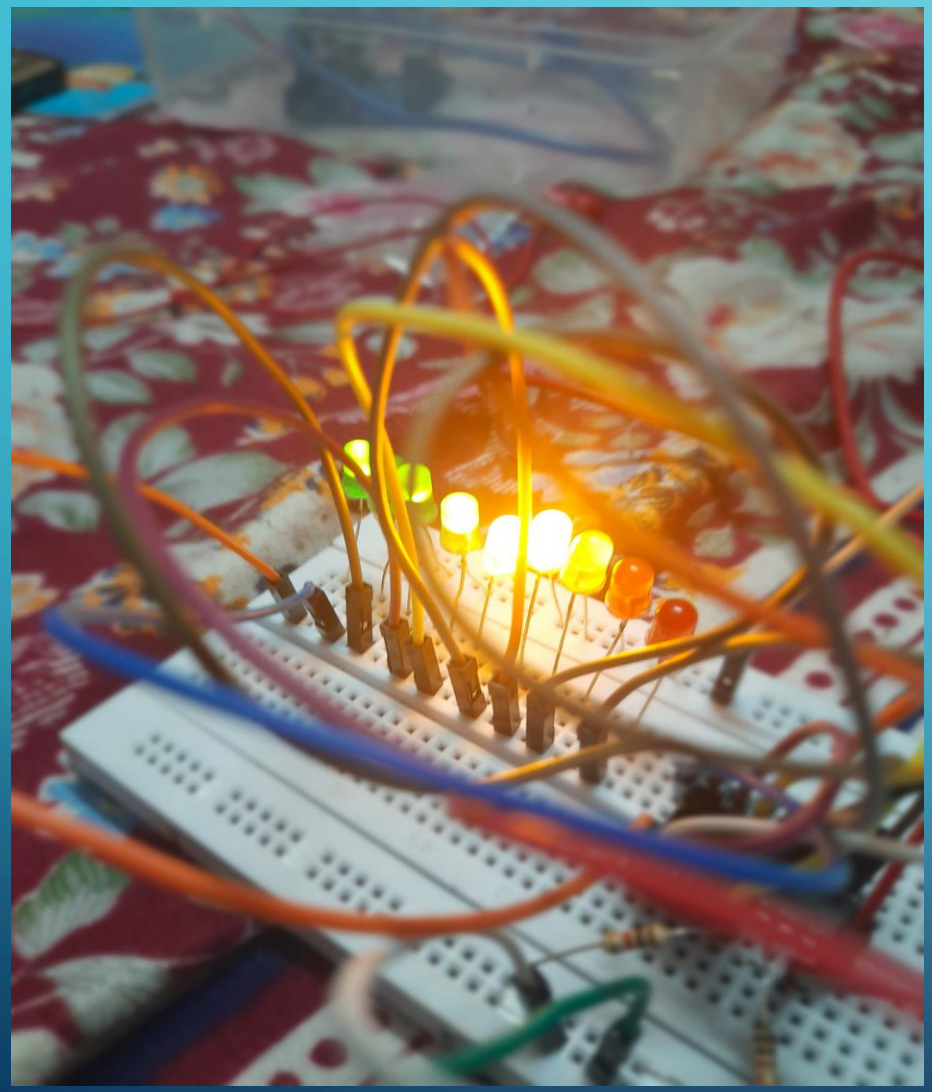
➢ CALIBARATION

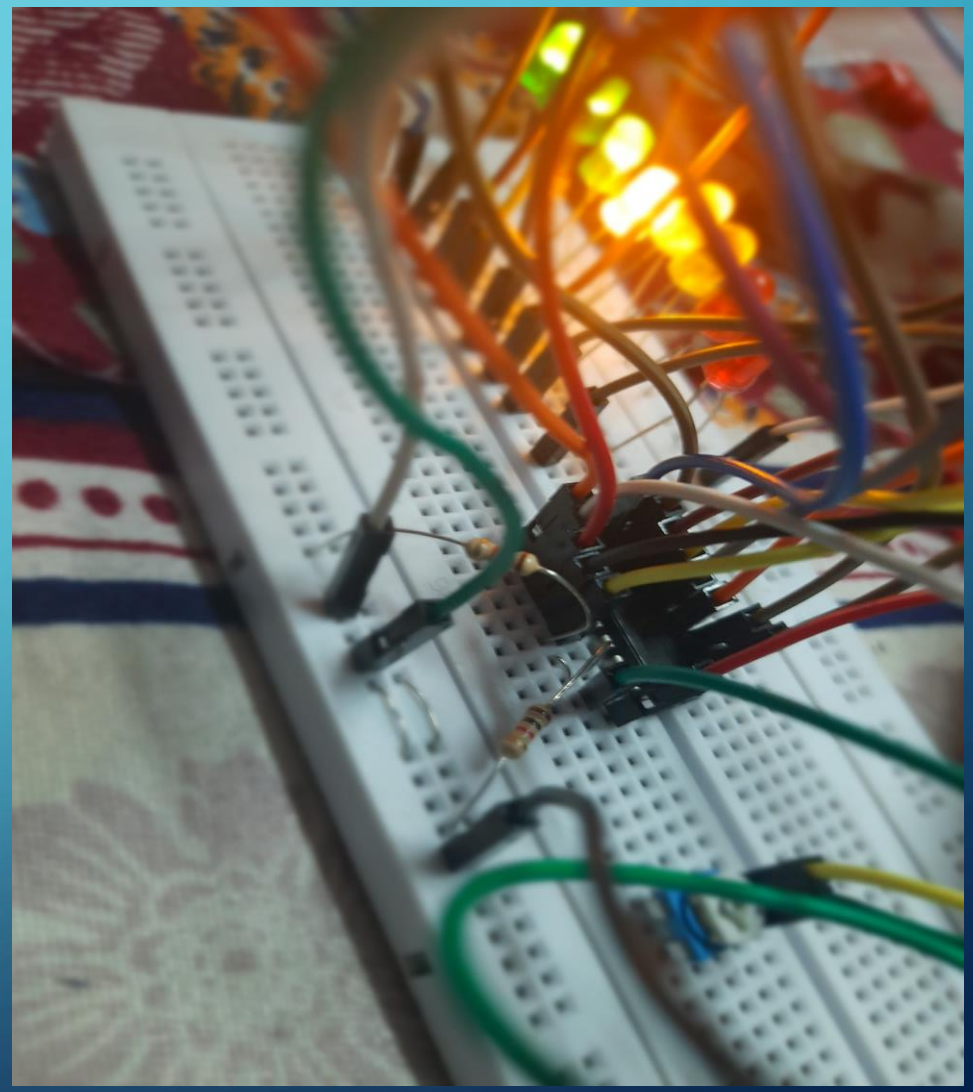
- Power up the circuit by connecting to 9V battery and switching on switch S. Calibrate the LM3914 by using a digital multimeter. Adjust VR3 until pin 6 of LM3914 has a value of 3.385V. After this, do the same for pin 4 until it has a value of 2.505V by adjusting VR2.
- Next, place a thermometer near to LM34 in a room that has a temperature range of 62-80 Fahrenheit but not touching it. Adjust VR1 until the correct LEDs light up based on the room temperature measured.
- The input voltage at pin 5 of U1 is given by the formula:
- **Vin = 0.225 + (0.04 X T)** where T is the room temperature in Fahrenheit.
- Use this formula to check the voltage and the temperature measured.

LM35 PIN ASSIGNMENT



OUTPUT





➢ APPLICATIONS OF DIGITAL LED THERMOMETER

- DIGITAL LED THERMOMETERS are can be used in following industrial areas:

1)Manufacturing

2)Automotive

3)HVAC

4)Food and Beverage

5)Construction

6)Marine and Petrol Industries

and other applications.

➢ ADVANTAGES OF DIGITAL LED THERMOMETERS

- The advantage of LM34 over a thermistor is that the output voltage is linear whereas the thermistor has resistance characteristics that is non-linear. It is also more accurate compared to a thermistor.
- The only setback is that it is more costly compared to a thermistor.
- You can use different LED colors to display the room temperature.
- For instance L1, L2, L3 and L4 can be green. L5, L6, L7 can be orange and L8, L9, L10 red.
- This will help to differentiate the temperature of the room from afar.
- The supply voltage used in this project is 9V DC which is easily available from a typical 9V dry cell battery.

➢ FURTHER IMPROVEMENTS

1) BATTERY

Dead batteries are a drawback of digital thermometers. It is hard to determine how much power is left in a digital thermometer's battery, which in turn makes it difficult to predict when it will die. Because they are specialised batteries, it is hard to locate replacements. And close-to-dying batteries will provide inaccurate readings. Replace your battery annually to prevent power-related problems.

IMPROVEMENTS:

- Can incorporate a charging module instead of batteries.
- Using Solar power to recharge is also an alternative way

➢ FURTHER IMPROVEMENTS

2) DIGITAL ACCURACY

Not all digital thermometers are as reliable as others. For example, you want to steer clear of using digital ear thermometers. At first glance, they do appear as the easier choice between taking a rectal temperature or having a fussy child hold a thermometer under his or her tongue. But sometimes, they do not register fevers at all, according to Liverpool University Institute of Child Health researchers. These thermometers can also have a one or two degree difference compared to rectal or oral readings.

IMPROVEMENTS:

- Use of more advanced digital circuits.
- Avoiding manufacturing defects.
- Gentle handling of the device is adviced.

➢ FURTHER IMPROVEMENTS

3) COMPACTIBILITY

Compactibility is one another issue. Today's world requires electronic devices to be smart and compatible.

IMPROVEMENTS:

- Usage of PCB Boards and Fabrication Techniques.
- Manufacturing the components in a small size

➢ FURTHER IMPROVEMENTS

4) CLEANING(WEAR AND TEAR)

While it is easy to submerge a regular thermometer in warm, soapy water, it is more difficult to do so with a digital thermometer. You have to be careful not to get a digital thermometer too wet or you will mess up the mechanical system, and it will no longer work. It is recommend you use cool, soapy water only on the tip of a digital thermometer. Some digital thermometers even come with disposable tips to help with this situation.

IMPROVEMENTS:

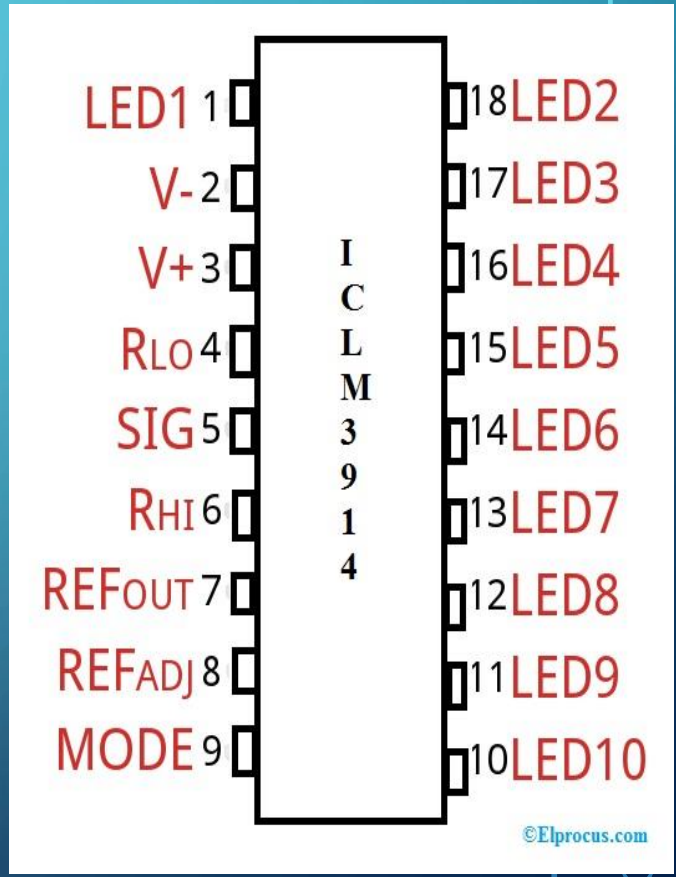
- USAGE OF METALIC COATINGS.
- USAGE OF ALLOYS IN MANUFACTURING.
- MANUFACTURING THE COMPONENTS WITH MORE HARDNESS.

➢ LM3914 IC WORKING AND SIMULATION

- The IC LM3914 is one kind of integrated circuit, mainly used to activate displays that visually display an analog signal's magnitude.
- A single IC can drive many displays like 10 LCDs, vacuum fluorescent otherwise LED displays.
- A single LM3914 can drive up to 10 LEDs, LCDs, or vacuum fluorescent displays on its outputs.
- The output threshold linear scaling will make the apparatus functional like a voltmeter. In the basic pattern, it gives a 10 step scale which is flexible to over hundred sections with additional LM series integrated circuits in series.
- Two alternatives to this IC are the LM3915 and LM3916.

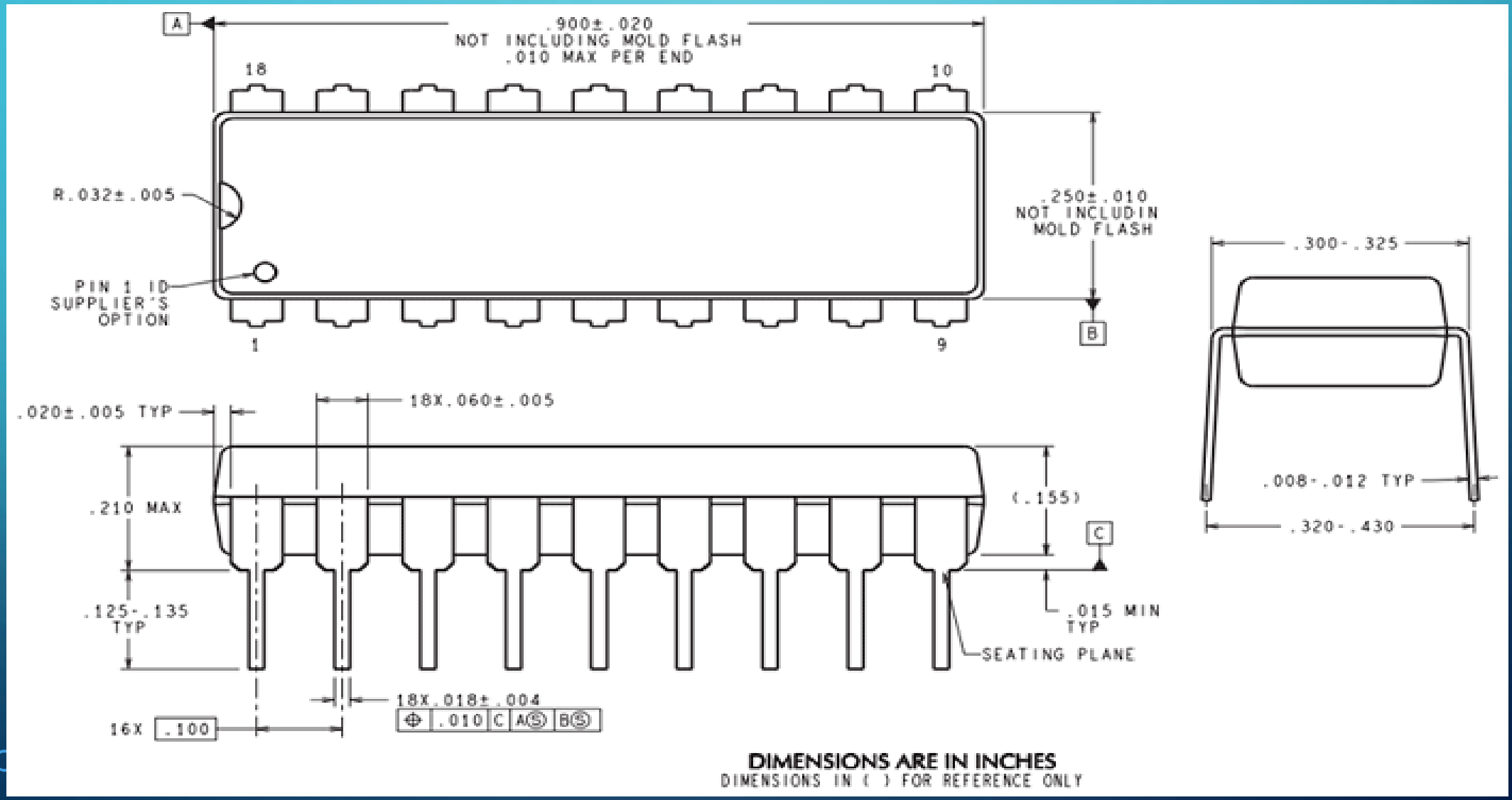
LM3914 IC WORKING AND SIMULATION – PIN CONFIGURATION

- The DIP version (Dual-inline Package) of this IC includes 18-pins, where the polarity can be specified with both a notch as well as a dot. Half of the pins of this IC can be in charge of driving the light emitting diodes, and the remaining pins are used for controlling the IC, reference voltages and power.



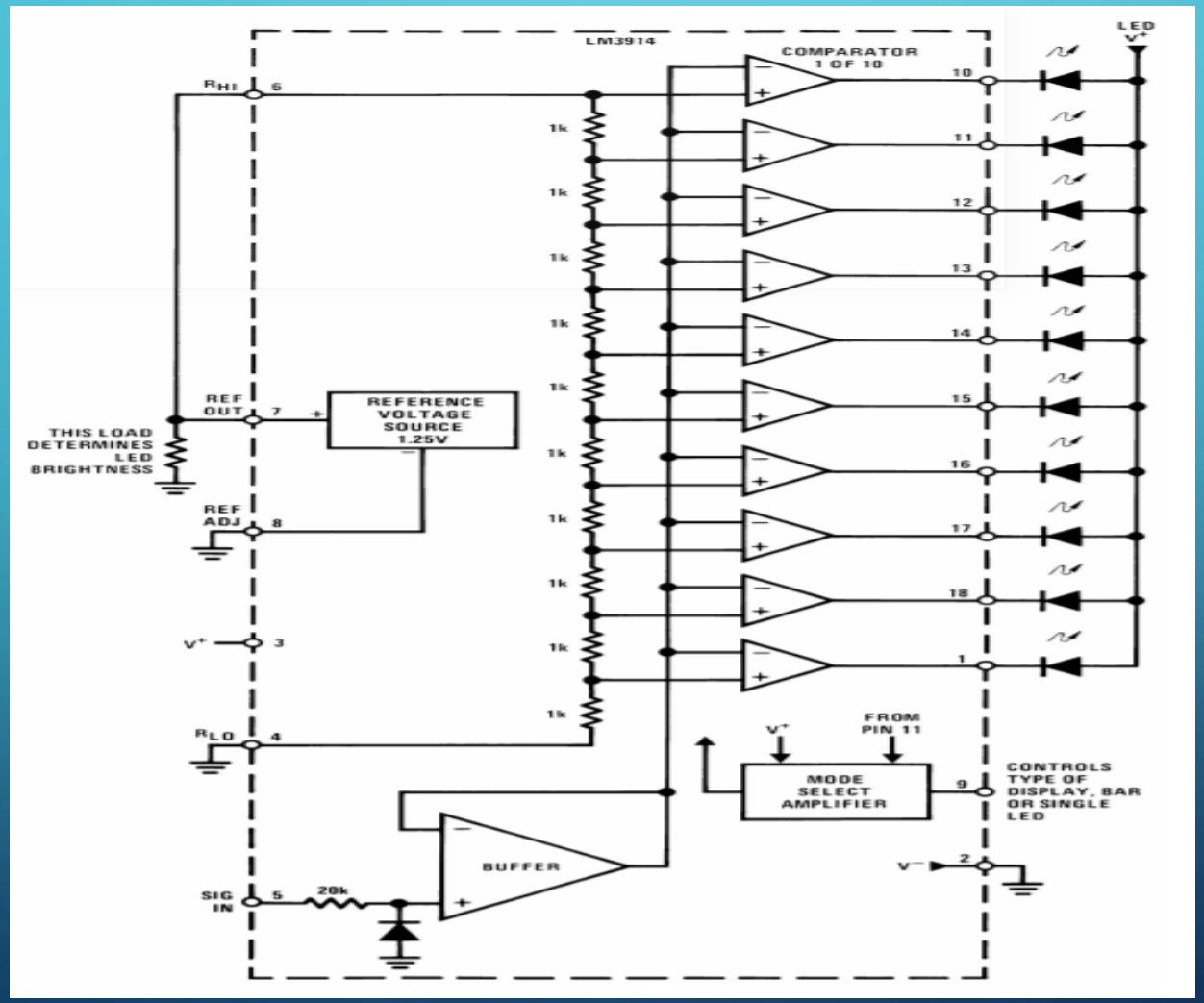
- Pin1: (LED1, LED2, LED3,..LED10): The LED which has to be operated is allied to these pins
- Pin2: (V- or Ground): GND pin of the integrated circuit
- Pin3: (V+ or Vcc): Supply voltage ranges from 3V to 18V
- Pin4: (RLO): Low-level voltage used for potential divider
- Pin5: (Signal): Input pin analog signal based on which the LED is controlled.
- Pin6: (RHI): High-level voltage used for potential divider
- Pin7: (Ref Out): Reference voltage of Output for limiting the LED current
- Pin8: (Ref Adj): Adjust pin used for voltage reference
- Pin9: (Mode): Choose among Dot or Bar Mode

LM3914 IC WORKING AND SIMULATION – PRECISED STRUCTURAL DIAGRAM



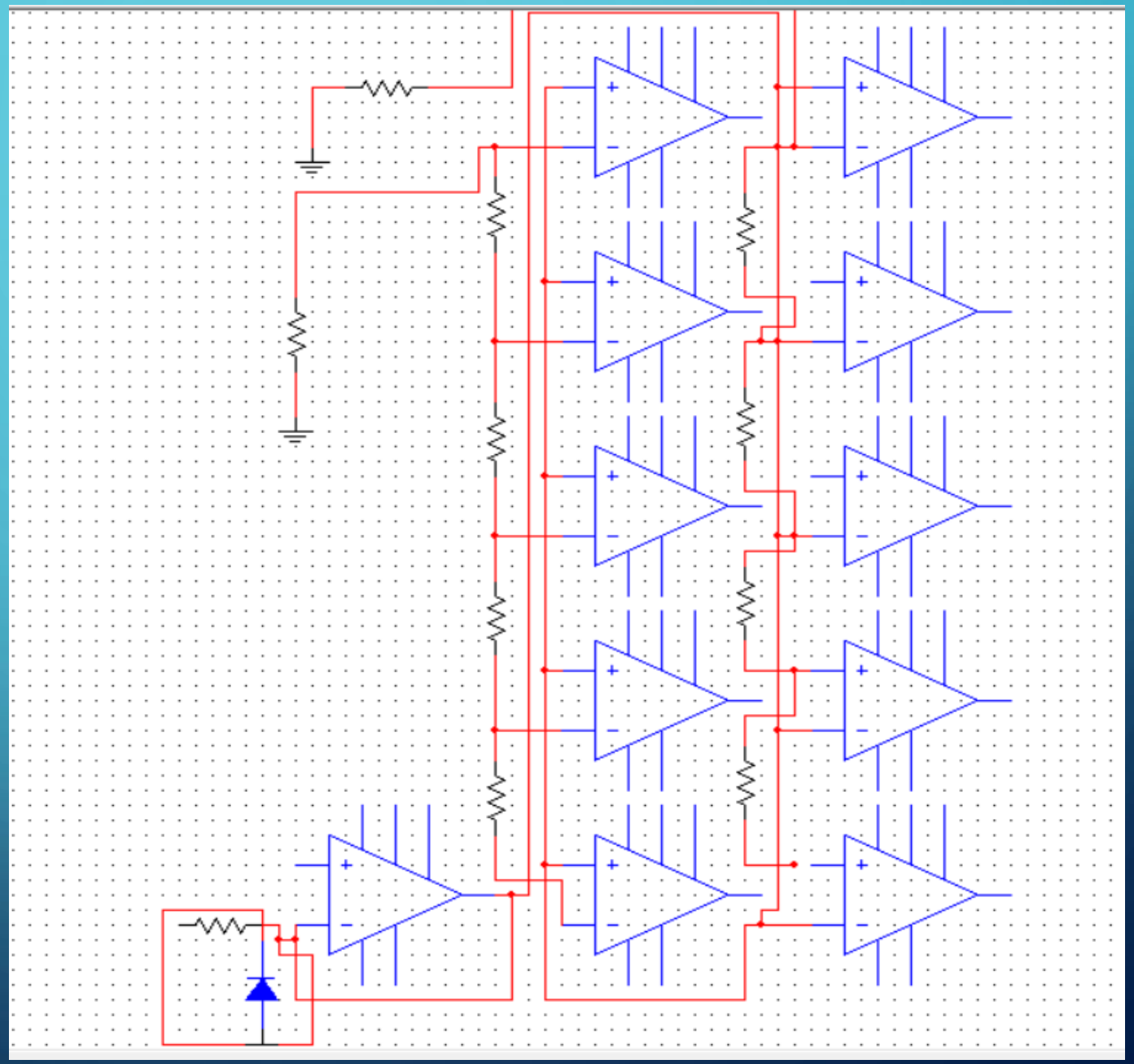
LM3914 IC WORKING AND SIMULATION

- The internal structure of LM3914 is compatible with this figure.



LM3914 IC WORKING AND SIMULATION

- We have only simulated the internal structure of LM3914 as shown in previous slide.



LM3914 IC WORKING AND SIMULATION

- The features of the LM3914 IC include the following
- It can drive LCDs, LEDs otherwise vacuum fluorescents. The dot otherwise bot display mode can be selected by the user externally.
- It can be expandable upto100 displays.
- The internal voltage ranges from 1.2V-12V
- The operating voltage will be less than 3V
- The programmable output current ranges from 2 mA-30 mA
- Multiplex switching is not necessary or communication among outputs.
- The outputs of LED drivers are open collectors and current regulated.
- The outputs interfacing can be done by CMOS logic otherwise TTL
- We can find more about LM3914 from here.
- https://www.ti.com/lit/ds/symlink/lm3914.pdf