MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY

COURSE CODE: EECE 208

PROJECT TITLE

OVER HEAT DETECTOR WITH AUTO CUT-OFF SYSTEM USING OP-AMP

GROUP NO: 02

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Introduction:

In our daily life we may face various phenomena of overheating. Every electronics device including mobile phone, laptop faces the problem of overheating. In broader cases Mechanical device like boiler, engine overheats and if we don't take necessary measures the outcome can be fatal. So overheat detector is of utmost importance. The project is about making a model of overheat detector by using various sensors and operational amplifier.

Objectives:

1. To sense heat from various electronic devices like amplifiers, computer and thus generates the warning alarm.

2. To introduce auto cut-off system in order to disconnect the circuit from heat source whenever over heat is detected.

3. To help in the reduction of property damage caused by fire, explosion due to overheating.

Theoretical Background:

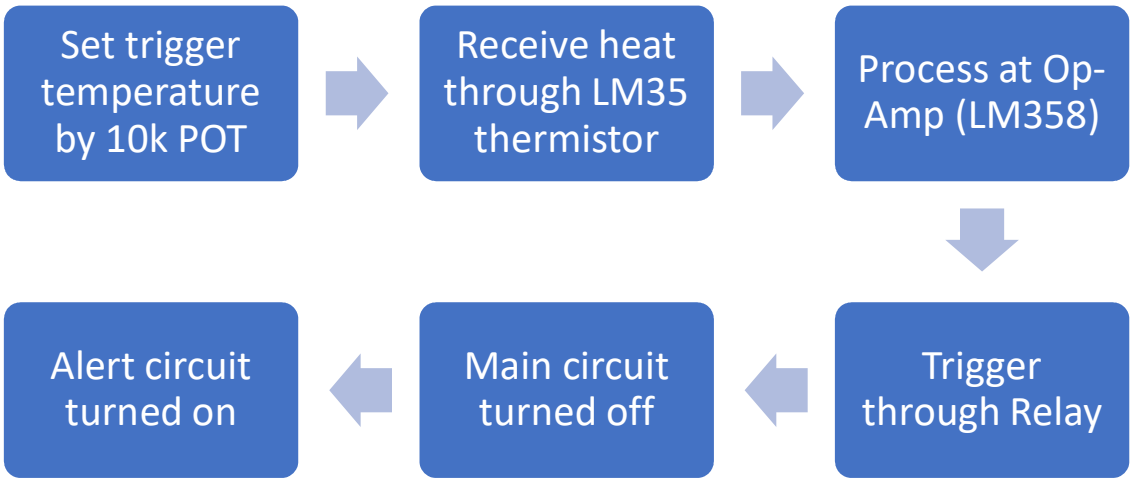
Overheating is a phenomenon of rising temperatures in an electrical circuit. Overheating causes damage to the circuit components and can cause fire, explosion, and injury. Damage caused by overheating is usually irreversible; the only way to repair it is to replace some components. When overheating, the temperature of the part rises above the operating temperature. Overheating can take place:

- if heat is produced in more than expected amount, or
- if heat dissipation is poor, so that normally produced waste heat does not drain away properly.

Overheating may be caused from any accidental fault of the circuit (such as short-circuit or spark-gap), or may be caused from a wrong design or manufacture (such as the lack of a proper heat dissipation system).

In order to reduce the damage caused from overheating, we can use over-heat detector circuit. In this kind of temperature sensing circuit, we use relay for the purpose of auto cut-off system from the heat source. As a result, we will be able to avoid unexpected accidents such as fire, explosion and save properties from being damaged.

Basic Flow Diagram:

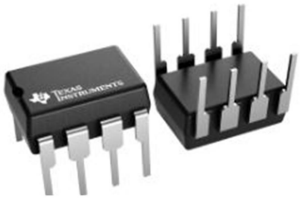


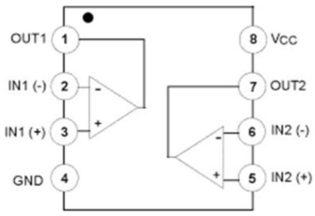
Equipment Required:

Serial No.	Name of the Apparatus	Rating	Quantity
1	OP-AMP	LM358	1
2	Resistor	100Ω	1
		330Ω	2
3	Potentiometer	10K	1
4	Thermistor	LM35	1
5	LED	Red, Blue	2
6	Relay	5V Relay	1
7	Power Supply	9V Battery	1
8	Voltage Regulator IC	7805IC 5V	1

A slight description of some of these components is given below:

1. LM358p

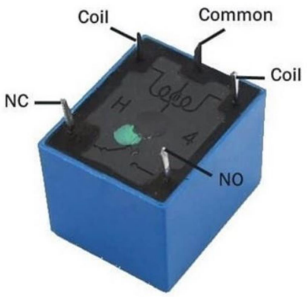




Two separate, low power, dual channel operational amplifiers with high gain and inbuilt frequency adjustment are found in the LM358p. Operating both op-amps in the LM358p will require a single power supply. A divided power supply is another option. The gadget's power supply voltage is low.
LM358p IC can also be utilized as transducer standard operational amplifier and it is suitable for our needs. It can manage current up to 20mA per channel and DC supply voltage ranging from 3V to 32V. Eight pins make up the device, which has two operational amplifiers.

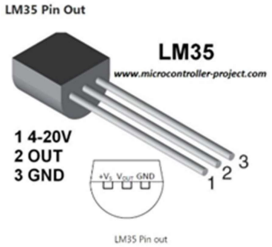
We have two operational amplifiers in this integrated circuit that we can utilize as a comparator. The LM358p is a good option for battery operation due to its low power consumption. Typically, the signals that we get from sensors have low ratings. If, for instance, we get 0.3V from a sensor, we are unable to do anything with this rating. We cannot turn on or off a led or relay with 0.3V. The LM358p IC receives the sensor's signal and compares it to the reference voltage. Then, by switching the output to high or low, this IC will determine whether the voltage is larger or lower than the reference voltage.

2. 5V relay switch



Relay works on the principle of electromagnetic induction. When the electromagnet is applied with some current, it induces a magnetic field around it. Above image shows working of the relay. A switch is used to apply DC current to the load.

3. LM35



Usually, a temperature sensor is a thermocouple or a resistance temperature detector (RTD) that gathers the temperature from a specific source and alters the collected information into an understandable type for an apparatus or an observer.The LM35 Thermistor along with Op-Amp LM358 has been used here for sensing temperature variations. We rotate the Potentiometer to adjust the sensitivity of the Sensor.

4. Voltage regulator IC

The function of a voltage regulator is to maintain a constant DC voltage at the output irrespective of voltage fluctuations at the input and (or) variations in the load current. In other words, voltage regulator produces a regulated DC output voltage.

Voltage regulators are also available in Integrated Circuits (IC) forms. These are called as voltage regulator ICs.

Circuit Diagram:

The circuit diagram of the Over Heat detector (both under normal condition and overheated condition) is shown below.

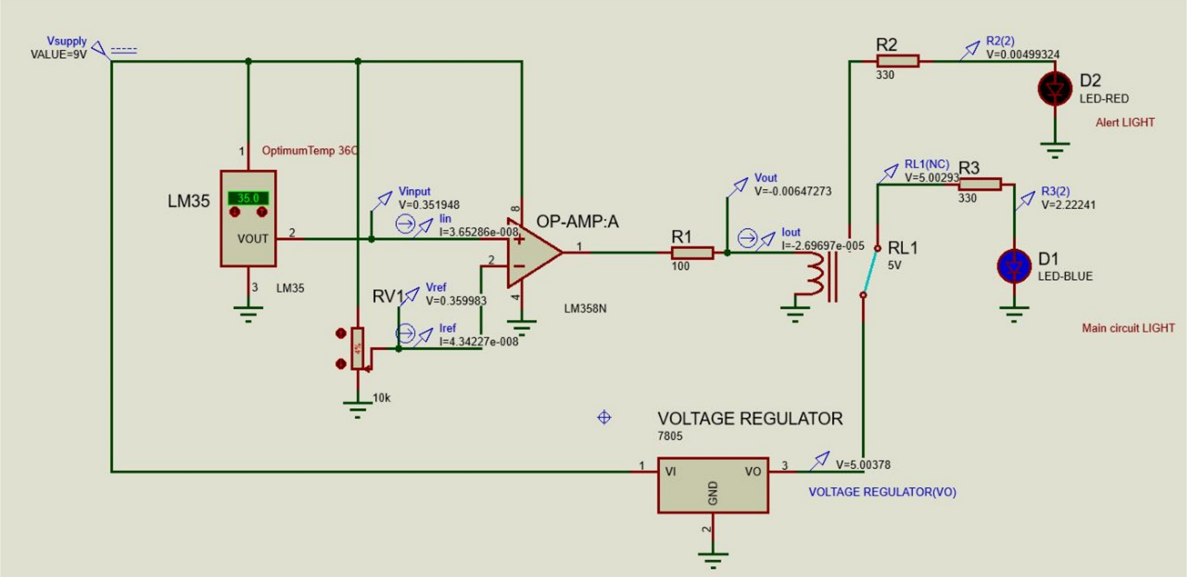


Fig: Circuit of Over Heat Detector when temperature is below trigger temperature (Main circuit light remains on)

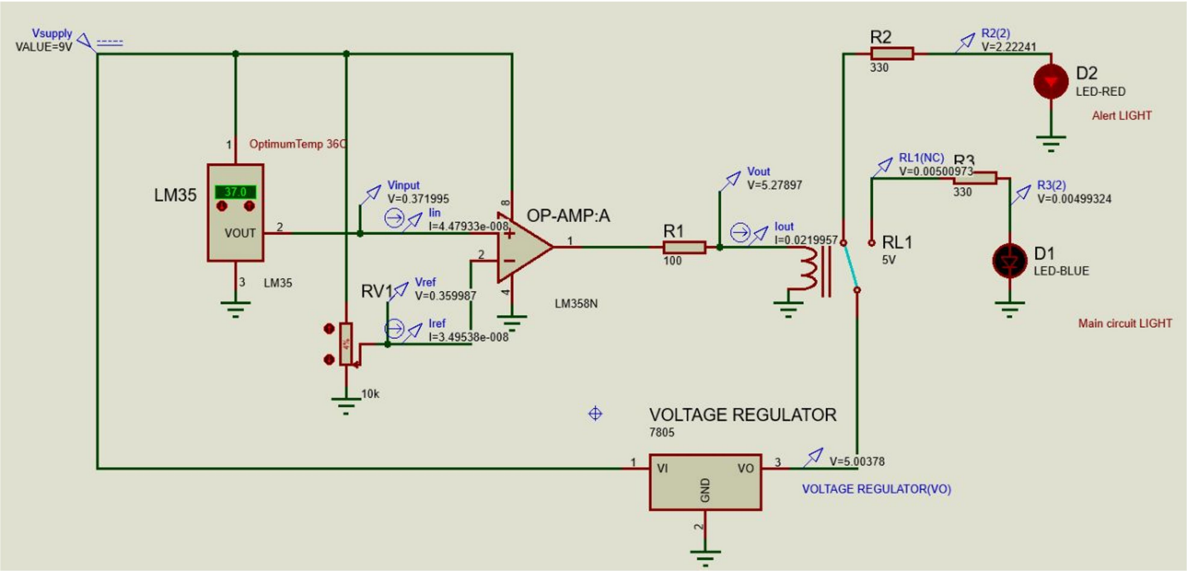


Fig: Circuit of Over Heat Detector when temperature is above trigger temperature (Main circuit light goes out and alert light turns on)

Working Principle:

Step 1: We have to connect the Overheat Detector model to the machine.

Step 2: Then we set a fixed temperature by using potentiometer (reference voltage)

Step 3: The temperature sensor will sense the machine temperature.

Step 4: After sensing the temperature the temperature sensor will send the signal to the non-inverting pin of LM358 as input voltage.

Step 5: If the temperature is above the set point (above reference voltage which is set by the potentiometer in the inverting pin of LM358), the output of LM358 will be higher than the relay voltage.

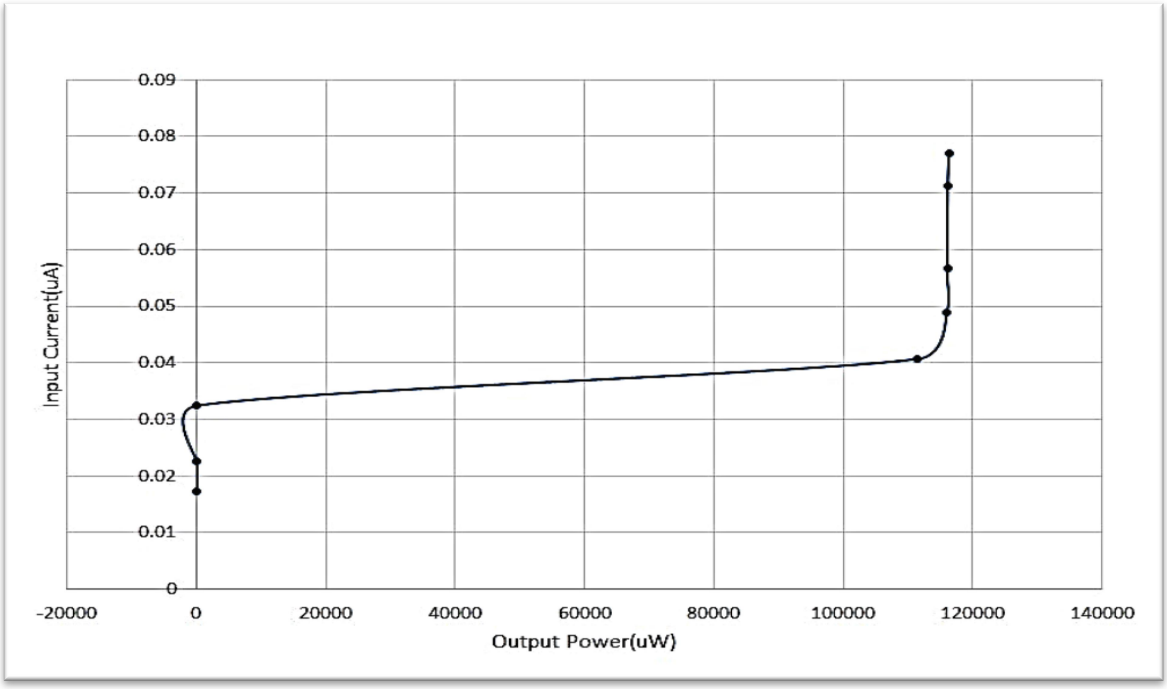
Step 6: Then the relay will disconnect the voltage source from the machine and the NC (normally closed) pin shifts into the NO (normally open) pin and our alert system will light up (red LED).

Step 7: The relay will again connect the source (NC pin) with the machine when the temperature drops than the optimum temperature which we set by the potentiometer.

Step 8: We test the circuit by using proteus software.

Experimental Data:

Supply (V)	Temp (°C)	Vi (V)	Ii (A)	Vref (V)	Iref (A)	Vo (V)	Io (A)	Po (W)	Status (alert light)
9V	30°C	0.3018	$1.73*10^{-8}$	0.3599	$5.30*10^{-8}$	-0.0075	-0.0000318	$2.346*10^{-7}$	off
	32°C	0.321	$2.25*10^{-8}$	0.3599	$5.57*10^{-8}$	-0.00729	-0.0000304	$2.215*10^{-7}$	off
	34°C	0.3419	$3.24*10^{-8}$	0.36	$4.76*10^{-8}$	-0.0069	-0.0000288	$1.986*10^{-7}$	off
	36°C	0.36	$4.06*10^{-8}$	0.36	$3.92*10^{-8}$	5.274	0.0219	0.1155	on
	38°C	0.382	$4.88*10^{-8}$	0.36	$3.079*10^{-8}$	5.279	0.02199	0.116	on
	40°C	0.402	$5.66*10^{-8}$	0.36	$2.287*10^{-8}$	5.28	0.022	0.1161	on
	45°C	0.452	$7.13*10^{-8}$	0.36	$7.7*10^{-9}$	5.28	0.22008	0.1162	on
	50°C	0.502	$7.7*10^{-8}$	0.36	$1.572*10^{-9}$	5.28	0.220093	0.1164	on



Result:

When the heat received through the thermistor becomes greater than the reference temperature, the Op-Amp becomes a non- inverting amplifier, and the gain is greatly increased. As a result, the output voltage exceeds 5V mark and the relay switches from NC position to NO position. Thus, the alarm is triggered and the main circuit is disconnected from the source.

Pros and Cons:

Pros:

This overheating detector can save the electrical devices or any machine from high temperature and reduce the damages of any electrical equipment. It can also protect against much bigger accidents. Also there are some other advantages:

- Reliable and accurate
- Economical
- Low energy consumption
- Easy to execute
- Less maintenance
- Users can set the temperature as required.

Cons:

The disadvantages of the temperature sensor include the following:

- The drawbacks of thermocouples are: least stability, nonlinearity, low voltage, required reference, sensitivity, etc.
- To measure negative temperature using LM35, it is required to give negative bias voltage.
- As we used a percentage dependent potentiometer, it can only set the optimum trigger temperature at a multiple of a certain temperature (in our case, 9°C). For example, it can only set the trigger temperature at (9*1) = 9°C, (9*2) = 18°C, (9*3) = 27°C, (9*4) = 36°C etc.

Applications:

I. This project can be used in Industries, companies, and homes to monitor the high-temperature conditions.
II. Dehumidifier, testing and inspection equipment, consumer goods, automotive, automatic control, data loggers, weather stations, home appliances, humidity regulator, medical and other humidity measurement and control.
III. HVAC (Heating, Ventilation and Air Conditioning) Systems
IV. Weather Stations
V. Medical Equipment for measuring humidity
VI. Home Automation Systems
VII. Automotive and other weather control applications
VIII. We can use this kind of project in such a farm that always needs a constant temperature.
IX. We can also use it in agricultural research.
X. In Industries.

Discussion:

The project "Overheat detection with auto cut-off system" has been successfully designed and tested. It has been developed by integrating features of all the hardware components used and software also in which we have used proteus. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. We conclude that by implementing these systems we can access the live data and control the device interfaced with our system.