Appliances Guard to Prevent AC Damage

Bhargavi Sampritha[1*], B. K. Varun[2], Kumar Kharvi[3], Ganapathi Sharma[4]

[1,2,3]*B.E. Student, Department of Electronics and Communication Engineering, Srinivas Institute of Technology, Valachil, India*

[4]*Professor, Department of Electronics and Communication, Srinivas Institute of Technology, Valachil, India*

*Corresponding author: bhargavishetty113@gmail.com

***Abstract*: This circuit monitors the AC current flowing through an electrical appliance and automatically turns the appliance off when the current goes beyond maximum or minimum threshold levels. If the appliance is drawing very high or very low current than the specified rated current, this indicates that there is a fault with the appliance. This guard is extremely useful where motors are used in the appliance or equipment.**

***Keywords*: Appliances, Guard, AC damage.**

1. Introduction

The electric power quality is becoming more and more important as society is growing increasingly dependent on electricity. So it is only natural that (undisrupted) quality energy delivery is paramount. Unplanned and unintended interruptions in the mains power supply such as short circuits, overload, voltage spikes. If the voltage is too high, this will cause appliances to run 'too fast and too high' which will shorten their service life. The tiny electronic circuits on circuit boards, motherboards, network adaptors, etc. Cannot cope with any additional current and voltage peaks. Without effective protection, the overvoltage's and high current can be caused, for example, by switching impulses of powerful engines welding equipment or other large electronic appliances. The devices that are used to protect the power systems from faults are called protection devices.
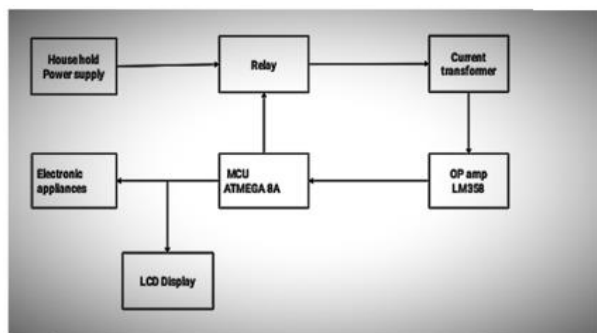

Fig. 1. Block diagram

Powering electronic devices requires controlled flow of voltage and current through it, any fluctuation in them might damage the device. In this project we have developed a system which this circuit monitors the AC current flowing through an electrical appliance and automatically turns the appliance off when the current goes beyond maximum or minimum threshold levels. If the appliance is drawing very high or very low current than the specified rated current, this indicates that there is a fault with the appliance. This guard is extremely useful where motors are used in the appliance or an equipment. This can be useful where expensive equipment's are used. Protection of appliances is very important as it can affect the user due to high current.

2. Working

The circuit measures AC current flowing through the appliance/equipment by continuously monitoring the current value, which is also displayed on the LCD. AC current drawn by the appliance is measured using current transformer CT, which has many turns of wire wound on a circular core. AC current carrying the conductor (say, phase, line or live wire) is passed through the core of CT, which produces voltage (or EMF) proportional to the current passing through it. Voltage generated is AC in nature, which is available across points A and B. This voltage is fed to op-amp, which is connected as a unity-gain amplifier.

Op-amp removes the negative half of the signals received from CT, so that only positive signals are fed to pin 27 of the MCU for analogue to digital converter (ADC). Internal ADC of the MCU measures the voltage continuously and records peak values, which are displayed on LCD.

The circuit trips (or switches off the relay) in case current goes beyond the set high value or lower than the set low value. Tripping occurs if either high- or low-current condition continues for around 10 seconds. This protects the appliance from further damage.

3. Software

The software (applianceguard.c) is written in C language. AVR Studio can be used to generate the hex code (applianceguard.hex) for programming ATmega8A MCU. You can use any suitable programmer to burn the hex code into the MCU. Delay can be adjusted in the code given below by modifying the value 60 to some other value.
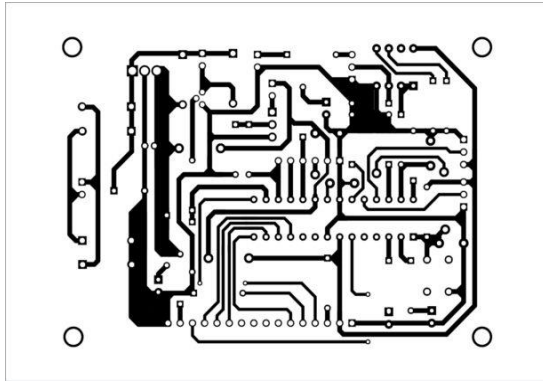
International Journal of Research in Engineering, Science and Management
Volume-3, Issue-8, August-2020
journals.resaim.com/ijresm | ISSN (Online): 2581-5792 | RESAIM Publishers

136

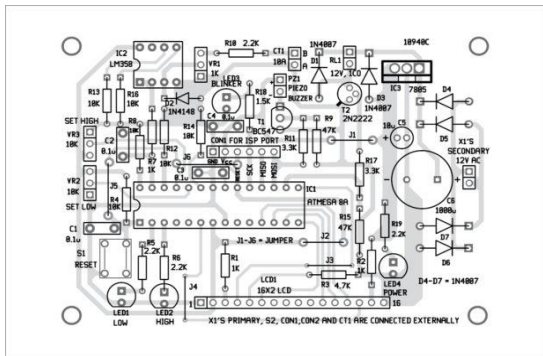Fig. 2. PCB layout of appliance guard

Fig. 3. Components layout for the PCB

4. Result and Testing

Assemble the circuit on the PCB and connect 12V AC secondary of transformer X1 to the PCB. Connect 230V AC, switch S2, primary of X1, CT1 and the appliance externally using suitable.

Once the circuit assembly is done, write/burn applianceguard.hex file to the MCU using a suitable programmer. Then, mount the MCU on the PCB. It is recommended to use a 28-pin IC base for the MCU. Keep VR1 and VR2 to the minimum and VR3 to the maximum positions.

Now, pass the phase/line wire of the appliance through CT1 and measure the current using a clamp meter, as explained in Calibration section below. Using S2, switch on the circuit and the appliance. Relay RL1 will get energised with a small delay and AC appliance will switch on.

5. Calibration

Make sure that one end of CT1 as well as VR1 is grounded. Only one line of AC power, phase or live (L) should pass through the current coil. AC current value is displayed on the first row of LCD1. Initially, value displayed on LCD1 may not be correct. Adjust VR1 slowly till LCD1 shows the value read on the clamp meter. Adjust VR2 till voltage at pin 24 of IC1 is low (0V) and adjust VR3 till voltage at pin 25 of IC1 is high (5V). Remove the clamp meter after adjustment and calibration.

To adjust the high or maximum limit to trip the relay, adjust VR3 to the required maximum current limit (say, 1.5 times the working current value displayed in the first row). Similarly, to adjust the low or minimum limit to trip the relay, adjust VR2 to the required minimum current limit (say, 0.5 times the working current). Now, the circuit is ready.

Once the value crosses the high or low limit, the buzzer will start beeping and the corresponding LED (LED1 or LED2) will start blinking. If blinking continues for more than 10 seconds, the corresponding LED will blink quickly and the relay will switch off, thus protecting the appliance or equipment. Press reset switch S1 to restart the program.

6. Conclusion

This paper presented an overview on appliances guard to prevent AC damage.

References

[1] Stephen M. Cary, "High voltage circuit breaker standards – Comparative Guide," IEEE, 2013.
[2] Austin H. bonnet, "IEEE safety consideration for the application, installation, operation, and maintenance of industrial AC induction motors."
[3] https://www.electronicsforu.com/electronics-projects/appliance-guard-prevent-damage
[4] https://www.elprocus.com/under-and-overvoltage-protection-circuit/
[5] https://diy.stackexchange.com/questions/55988/how-to-protect-my-home-from-high-voltage