TOPIC : PROLONG LIFE OF A COOLER PUMP

AIM: To prolong the life of the cooler pump and save its electricity too.

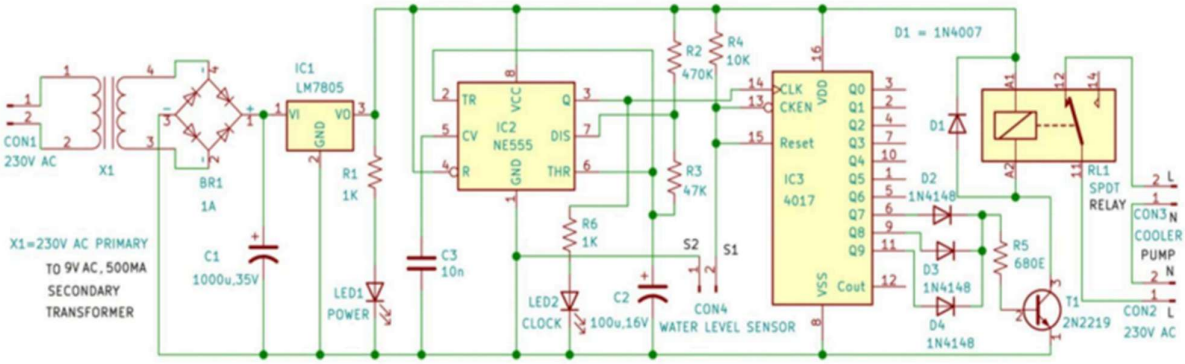
COMPONENTS REQUIRED :

Semiconductors :
IC1 - LM7805, 5V voltage regulator
IC2 - NE555 Timer
IC3 - 4017 decade counter
BR1 - 1A bridge rectifier
LED1,2 - 5mm LED
D1 - 1N4007 rectifier diode
D2-D5 - 1N4148 signal diode
T1 - 2N2219 NPN Transistor

Resistors and Capacitors :
R1, R6 - 1K ohm
R2 - 470K ohm
R3 - 47K ohm
R4 - 10K ohm
R5 - 680 ohm
C1 - 1000Uf, 35V electrolytic
C2 - 100Nf, 16V electrolytic
C3 -10nF ceramic disk

Others:
CON1-CON4 - 2 pin connector
S1 - water sensor probes(steel)
RL1 - 5V, 1C/O relay
X1 - 230V AC primary to 9V,500mA secondary transformer - Cooler pump

CIRCUIT DIAGRAM :



INTRODUCTION :

Dry-running protection for water pumps is one of the most important monitoring functions, as bearings and shaft seal may be damaged if the booster pumps run dry. So Stop water cooler damage with dry running protection is made. With this method, we can prevent our water cooler's motor from dry running and activate it for about one-third of the time only. This will reduce the wear and tear of the motor and save electricity too. Coolers are used in many homes, offices, schools, and industries, especially in summer.

So this device will come in handy to stop the cooler pump automatically when the cooler's tank has no water.

CONSTRUCTION :

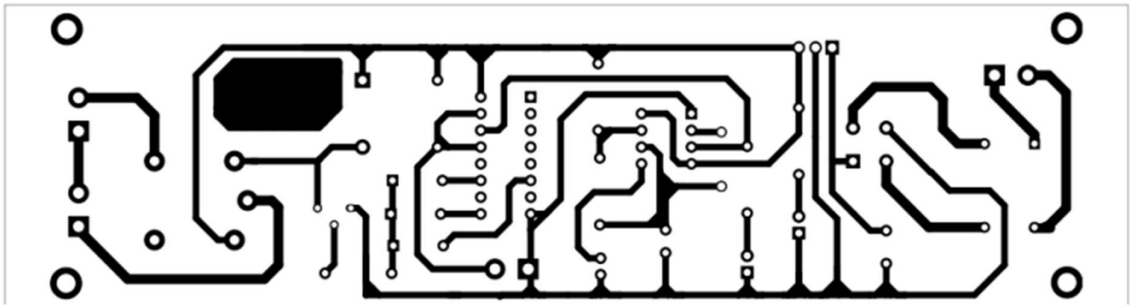
1) The circuit comprises step-down transformer X1, bridge rectifier, 5V voltage regulator LM7805(IC1), decade counter 4017 (IC2), rectifier diode(D1), signal diode (D2-D5), NPN transistor (T1), 5V single changeover relay, and a few other components. The 5V DC supply required for the circuit is derived from 230V AC to 9V, 500mA step-down transformer X1.
2) The 230V AC mains is connected to the primary winding of X1 via CON1 in the circuit. The secondary winding of X1 produces 9V AC, which is connected to the bridge rectifier for rectification and to capacitor C1 for filtration.
3) The rectified and filtered voltage is given to regulator IC LM7805 (IC1) to get regulated 5V for the circuit, whose presence is confirmed by the glowing LED1.
4) The 555 timer IC2 is wired in astable multivibrator mode. Based on the values of timing components R2, R3, and C2, the frequency of the output pulse is around 0.26Hz and its time period is around 40 seconds. This frequency can be changed by changing the timing components' values.
5) In place of R3,we can use a pot to vary output frequency. The flashing of LED2 indicates that the astable multivibrator is working well.
6) The clock pulse of the 555 Timer at its pin 3 is given to pin 14 of decade counter 4017 (IC3).
7) Pin 16 of decade counter IC3 is connected to supply and pin 8 (ground). Pin 13 (inhibit) and pin 15 (reset) together are connected to 5V via 10k resistor R4. These two pins are also connected to water sensor probes that are used to enable IC3.
8) One probe of the water sensor is connected to the junction of pins 13 and 15 and the other probe is connected to the circuit's ground through CON1.
9) The six outputs Q1 to Q6 of IC3 are not used. Its remaining three outputs Q7, Q8, and Q9 are connected to the anodes of respective diodes D2 through D4. The cathodes of D2 through D4 diodes are connected to each other and to the base of transistor T1 through resistor R5.
10) Only Q7, Q8, and Q9 output pins of IC 4017 are used to drive the relay to increase the off time of the pump. The pump remains off when the seven outputs Q1 through Q6 are high.

WORKING :

Complete the connections as mentioned and power on 230V AC. Relay RL1 is driven by transistor T1 when outputs Q7, Q8, and Q9 of IC2 go high to activate the cooler's pump. The pump will run only when water is available in the cooler's water storage tank, which is sensed by the sensor probe to enable IC2. The motor will run for around 1/3rd time and remain off for 2/3rd time.

When there is sufficient water in the cooler's water tank, the junction of pins 13 and 15 remains low because of water touching the sensor probe. In this case, IC3 switches the cooler pump on/off sequentially. When water is insufficient, the junction of pins 13 and 15 goes high. In this case, IC2 switches off the cooler pump so that it does not run dry.

PCB LAYOUT:



APPLICATIONS AND USES :

There are many applications of a stop water cooler with dry running protection. Few of them are:

1) Commercial Water Cooling systems
2) Industrial Cooling systems
3) Agricultural irrigation systems
4) Aquarium and fish tanks
5) Hydroponic systems
6) Domestic water coolers

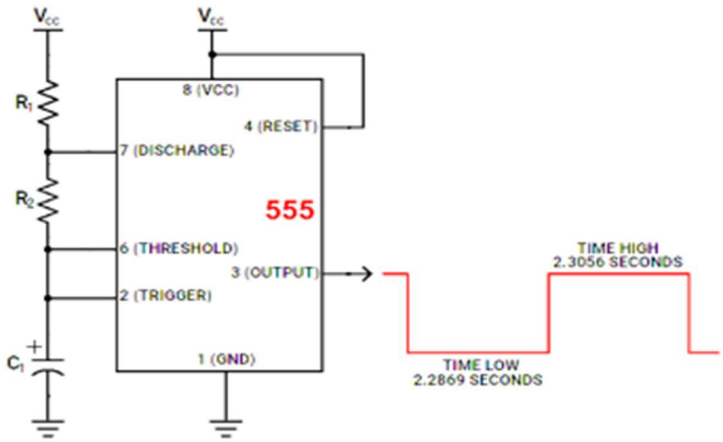
FURTHER SCOPE:

It can be used in industrial cooling systems, where instead of a pump supplying water in the cooler it can timely move water and thereby remove waste heat . [calculated]:

R_1 RESISTOR VALUE		R_2 RESISTOR VALUE	
1000	Ω	51959	kΩ

C_1 CAPACITANCE VALUE	
100	µF

Will have an on time of 1 hr and offtime of 1 hr.(perfect for large scale cooling) Easily deployable by farmers to water their farms . If a motor has access to water, then it will be able to water the farmland periodically without intervention of the farmer. [we can configure this system in such a way, that the farm lands are irrigated by making a connection such that after counting 7 the counter resets. This is done as there are 7 days in a week and resetting the counter on count of 7 will ensure that the watering will take place everyday.]



R_1 RESISTOR VALUE		R_2 RESISTOR VALUE	
270	Ω	33	kΩ

C_1 CAPACITANCE VALUE	
100	µF

FORMULAS

$$T_h = 0.693(R_1 + R_2)C_1 \qquad T_l = 0.693R_2C_1$$

$$f = \frac{1.44}{(R_1 + 2R_2)C_1}$$

TIME HIGH		TIME LOW	
2.3056	S	2.2869	S

FREQUENCY	
0.2173	Hz

RESULT AND CONCLUSION :

This is the clock, the “pump” works only for 3 consecutive clock pulses[when count in counter is 7/8/9] and switches off for rest of the counter outputs. Overall, the applications and uses of stop water cooler damage with dry running protection span various industries and settings where water cooling systems are employed, ensuring the efficient and safe operation of equipment and machinery.

PRECAUTIONS :

1) Make proper connections as shown in the circuit diagram.
2) Ensure that the power supply is within the range.
3) Double check the polarity of power supply connections to avoid reverse voltage.
4) Do no short circuit the ICs or breadboard.