

WATER-LEVEL CONTROLLER-CUM-MOTOR PROTECTOR



■ GURSHARANJEET SINGH KALRA

Many a time we forget to switch off the motor pushing water into the overhead tank (OHT) in our households. As a result, water keeps overflowing until we notice the overflow and switch the pump off. As the OHT is usually kept on the topmost floor, it is cumbersome to go up frequently to check the water level in the OHT.

Here's a microcontroller-based water-level controller-cum-motor protector to solve this problem. It controls 'on' and 'off' conditions of the motor depending upon the level of water in the tank. The status is displayed on an LCD module. The circuit also protects the motor from high voltages, low voltages, fluctuations of mains power and dry running.

Circuit description

Fig. 1 shows the circuit of the microcontroller-based water-level controller-cum-motor protector. It comprises operational amplifier LM324, microcontroller AT89C51, optocoupler PC817, regulator 7805, LCD module and a few discrete components.

The AT89C51 (IC2) is an 8-bit microcontroller with four ports (32 I/O lines), two 16-bit timers/counters, on-chip oscillator and clock circuitry. Eight pins of port-1 and three pins of port-3 are interfaced with data and control lines of the LCD module. Pins P3.0, P3.1 and P3.6 are connected to RS (pin 4), R/W (pin 5) and E (pin 6) of the LCD, respectively. Pin EA (pin 31) is strapped to Vcc for internal program executions. Switch S2 is used for backlight of the LCD module.

Power-on-reset is achieved by connecting capacitor C8 and resistor R14

to pin 9 of the microcontroller. Switch S1 is used for manual reset.

The microcontroller is operated with a 12MHz crystal. Port pins P2.0 through P2.2 are used to sense the water level, while pins P2.3 and P2.4 are used to sense the under-voltage and over-voltage, respectively. Pin P3.4 is used to control relay RL1 with the help of optocoupler IC3 and transistor T5 in the case of under-voltage, over-voltage and different water-level conditions. Relay RL1 operates off a 12V supply. Using switch S3, you can manually switch on the motor.

The LM324 (IC1) is a quad operational amplifier (op-amp). Two of its op-amps are used as comparators to detect under- and over-voltage. In normal condition, output pin 7 of IC1 is low, making pin P2.3 of IC2 high. When the voltage at pin 6 of N1 goes below the set reference voltage at pin 5 (say, 170 volts), output pin 7 of N1 goes high. This high output makes pin P2.3 of IC2 low, which is sensed by the microcontroller and the LCD module shows 'low voltage.'

In normal condition, pin 1 of N2 is high. When the voltage at pin 2 of N2 goes above the set voltage at pin 3, output pin 1 of N2 goes low. This low signal is sensed by the microcontroller and the LCD module shows 'high voltage.'

Presets VR1 and VR2 are used for calibrating the circuit for under- and over-voltage, respectively.

The AC mains is stepped down by transformer X1 to deliver a secondary output of 12V at 500 mA. The transformer output is rectified by a full-wave bridge rectifier comprising diodes D5 through D8, filtered by capacitor C2, and used for the under- and over-voltage detection circuitry.

PARTS LIST

Semiconductors:	
IC1	- LM324 quad op-amp
IC2	- AT89C51 microcontroller
IC3	- PC817 optocoupler
IC4	- 7805, 5V regulator
T1-T4	- BC548 npn transistor
T5	- SL100 npn transistor
D1-D14	- 1N4007 rectifier diode
Resistors (all 1/4-watt, 5% carbon):	
R1, R2, R7	-
R11, R12	- 1-kilo-ohm
R3, R9	- 560-kilo-ohm
R4, R5, R8	- 2.7-kilo-ohm
R6	- 330-ohm
R10	- 470-ohm
R13	- 100-ohm
R14	- 10-kilo-ohm
R15-R17	- 500-kilo-ohm
R18-R20	- 2.2-kilo-ohm
R21, R22	- 33-ohm
RNWT	- 10-kilo-ohm resistor network
VR1, VR2	- 470-ohm preset
VR3	- 10-kilo-ohm preset
Capacitors:	
C1-C3	- 1000µF, 35V electrolytic
C4	- 220µF, 16V electrolytic
C5, C6	- 33pF ceramic disk
C7	- 100µF, 35V electrolytic
C8	- 10µF, 16V electrolytic
Miscellaneous:	
X1	- 230 AC primary to 12V, 500mA secondary transformer
RL1	- 12V, 1C/O relay
X _{osc}	- 12MHz crystal
S1	- Push-to-on switch
S2, S3	- On/off switch
	- LCD module (1×16)

The transformer output is also rectified by a full-wave bridge rectifier comprising diodes D1 through D4, filtered by capacitor C1 and regulated by IC4 to deliver regulated 5V for the circuit.

When water in the tank rises to come in contact with the sensor, the base of transistor BC548 goes high. This high signal drives transistor BC548 into saturation and its collector goes low. The low signal is sensed by

Water Level Controller Cum Motor Protector

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