by Nigel Fawcett

In response to the 8-channel fluid detector project in Vol. 3 Number 11, many requests have been received asking for more detailed information on how to use the digital outputs to control mains devices. The first, and simplest form, was how to replace any of the LED's with the coil of a relay. This is achieved by removing the 1k load resistor (R3, 5, 7, 9, 11, 13, 15, 17 depending on which channel is being used), and replacing it with a 100 ohm resistor. The LED is also removed and this is replaced by the coil of the relay. The relay should have a coil resistance of approximately 300 ohms, and a nominal voltage of 12V DC. The new output stage is shown in Figure 1.

If a channel is used to switch the mains and the LED is also required then the circuit shown in Figure 1 is needed in addition to the output stage on the Fluid Detector PCB. A flying lead from the IC side of the 10k resistor (IC3 and R4, 6, 10, 12, 14, 16, 18, depending on which channel is being used) must be taken to a separate board with the relay drive circuit on it. Refer to Figure 2. This modification satisfies the requirements of the nurseryman and his greenhouse mist sprayers, as described in the original article.

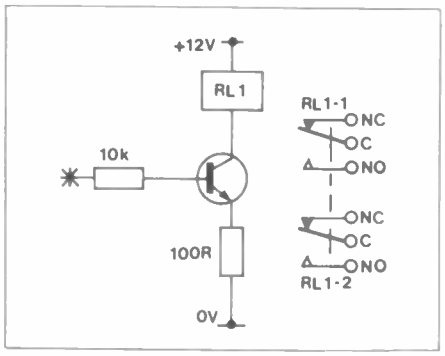


Figure 1. Relay driver

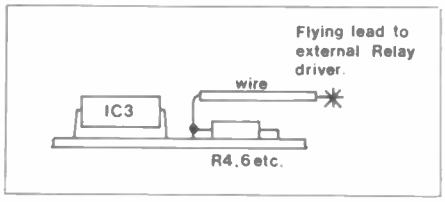
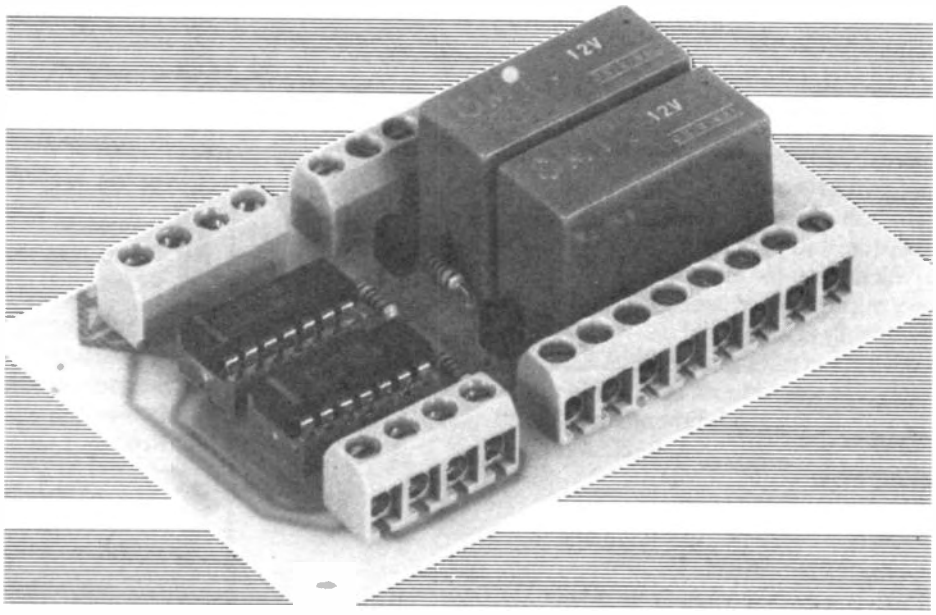


Figure 2.



The second and more complicated control circuit is used, for example, where a tank is gradually filling up with water, which must be pumped out to prevent the tank from overflowing. In addition, the water flowing into the tank can be turned off by mains controlled valves. It is decided that the pump should not start emptying the tank until it is half full, but should continue to pump out the contents until the tank is empty. If the inflow of liquid exceeds the outflow and the tank becomes full, then the inlet valves must be closed and remain closed until the tank is half empty. The requirements for the pump and the inlet valves

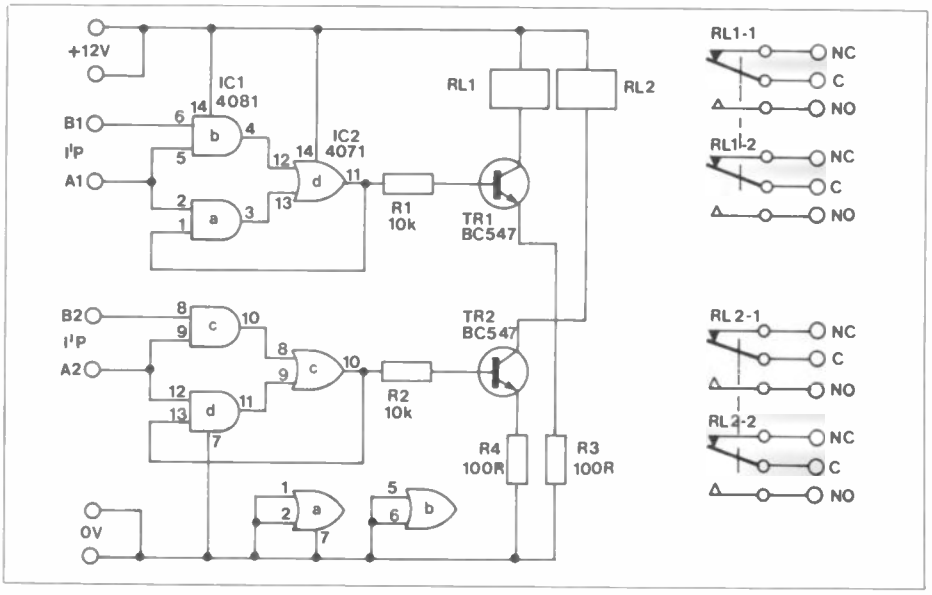


Figure 3. Circuit diagram

MAINS CONTROLLER FOR 8-CHANNEL FLUID DETECTOR

are actually the same, so two identical circuits are required. The logic for the circuit shown in Figure 3 is that the relay should be energised when two separate inputs are both 'high' and remain energised until both return to the 'low' state. In point of fact, only the 'A' input need go 'low' to release the relay, but the application hardware ensures that the 'B' input must logically already be 'low' before the 'A' input too becomes 'low'.

This second modification is the one that was used for the darkroom/workshop described in the original article. Figure 5 demonstrates this application in use.

Circuit Description

The circuit consists of two identical circuits, each of which comprise two AND gates, one OR gate, a relay driver and a relay. The 'A' input is used as the control input and is connected to both of the AND gates. The 'B' input is connected to one of the AND gates, and the outputs from the AND gates are in turn connected to the inputs of the OR gate. The output from the OR gate is used to control the relay, but is also fed back to the input of the other AND gate. When 'A' and 'B' are both low then the inputs to the OR gate are also low, holding the output low as well. When the 'A' input is taken high nothing changes, but when the 'B' input is also taken high the output from that AND gate goes high and in turn the OR gate output goes high, this switches the relay driver, but as the output is also fed back to the second AND gate, the output from the OR gate is latched high even when the 'B' input returns to the low state. The OR gate output will only return low when 'A' is also returned to the low state.

Construction

All components are fitted on the printed circuit board (see Figure 4). Start by inserting, and soldering the resistors, proceed with the IC sockets and PC terminals, followed by the transistors and the relays. Finally insert the IC's into their sockets. The 12V power supply is taken from the 8-channel fluid detector. Provision has been made on the PC terminals for the relays, for connecting earth wires, one of these should be taken to the earth point on the power supply.

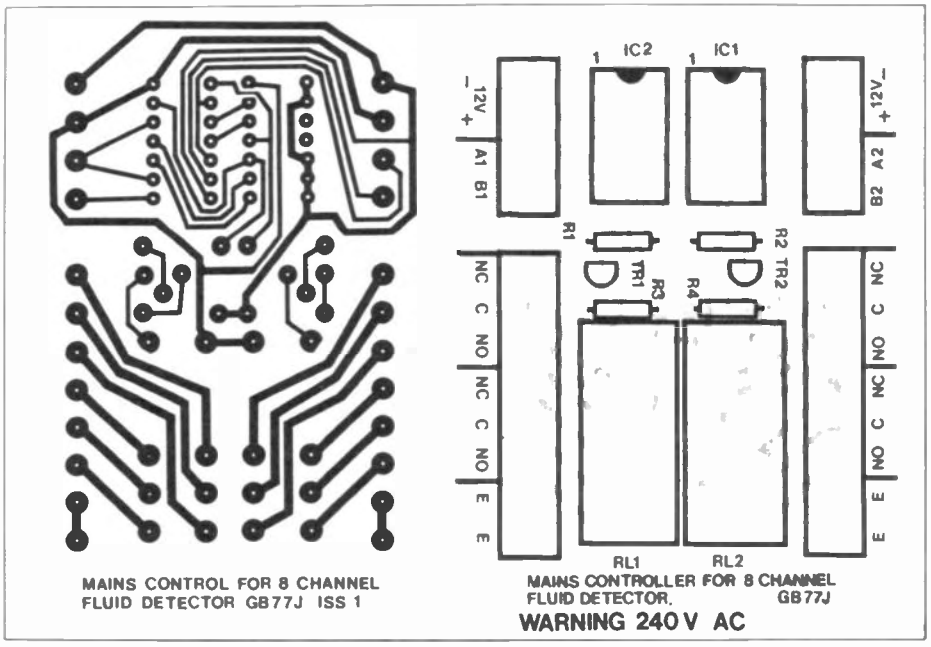


Figure 4. PCB track layout and overlay

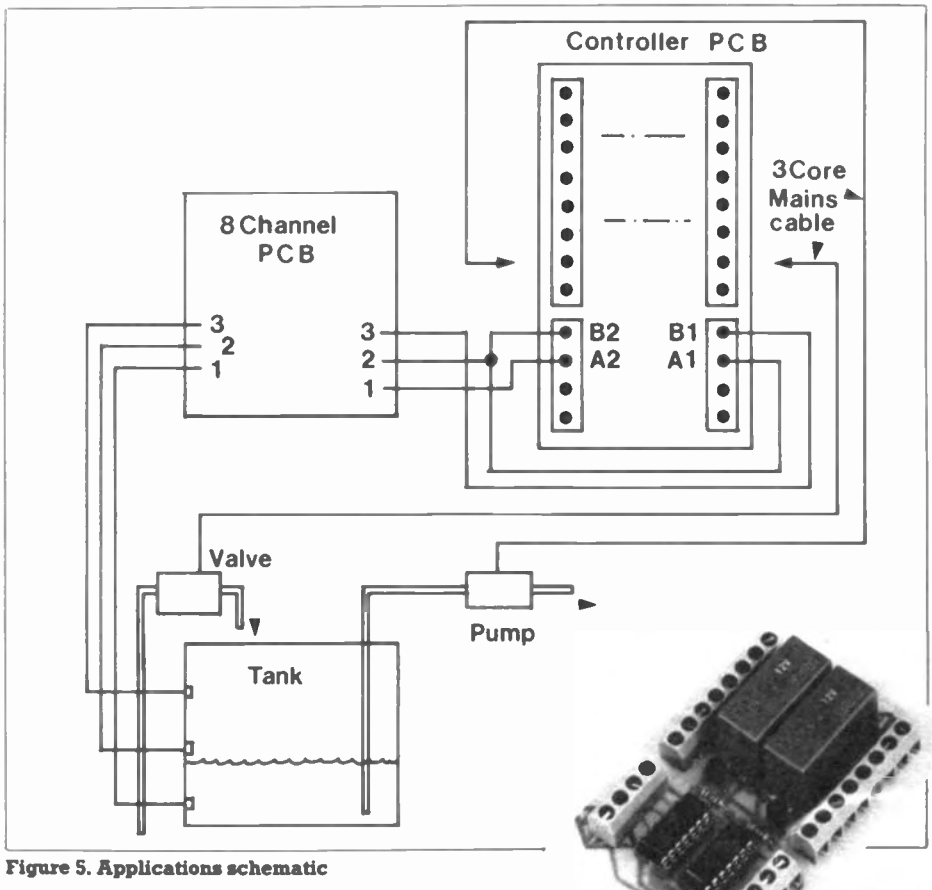


Figure 5. Applications schematic

PARTS LIST FOR MAINS CONTROLLER

RESISTORS: All 0.4W 1% Metal Film			
R1,2	10k	2	(M10K)
R3,4	100Ω	2	(M100R)
SEMICONDUCTORS			
TR1,2	BC547	2	(QQ14Q)
IC1	4081BE	1	(QW48C)
IC2	4071BE	1	(QW43W)
MISCELLANEOUS			
RL1,2	5A Mains Relay	2	(YX98G)
Printed Circuit Board		1	(GB77J)
PC Terminal 4-way		2	(RK73Q)
PC Terminal 8-way		2	(RK38R)
DIL Socket 14-pin		2	(BL18U)

A Kit containing the parts listed above is available.
Order As LK59P (Mains Controller Kit) Price £8.95

The Mains Control PCB is available separately.
Order As GB77J (Mains Control PCB) Price £2.99