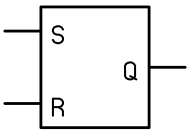
A Kit A Month: Parcel 4

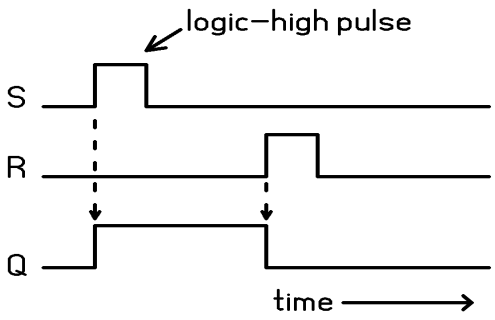
In the last parcel we used an *analogue* integrated circuit. This month, we will step into the world of *digital* electronics with a circuit that uses a very famous IC. If you look at any hobby electronics websites or books then it won't be long until you come across a circuit that uses a **555** chip: it's a very flexible chip that can be used as an 'astable', a 'monostable' or a 'bistable'. By all means go and look up what those terms mean, but the one that interests us here is the *bistable*, also called a 'latch' or 'flip flop'. In fact, the chip we are using is a 556 which is two 555's squeezed into one package, so we actually have two latches at our disposal.

But what is a latch? Well, imagine a circuit where you press a button to turn on a buzzer. The buzzer would only sound when the button was pressed. But what if you wanted to press the button once and then have the buzzer continue to sound even once you'd let go of the button (e.g. for a fire alarm)? Then you'd need a *latch*. We draw a latch as a simple box with an output (Q) and two inputs: SET (S) and RESET (R).



(Note: although not shown in the block diagram for the latch, extra connections would be needed to connect to the power supply / battery).

A latch is quite simple: the output can be high or low but, importantly, it *stays* at whatever logic level it currently is at until it is told to change. The latch is 'told' to change by applying a logic high pulse to either its S (SET) or R (RESET) input. So, if the latch's output was currently low, you could make it go high by applying a logic high pulse to its SET input. The output would then remain high until the latch received a logic high pulse on its RESET input at which point the output would go to logic low.



Just to complicate matters, it is quite common for latches to have 'active-low' inputs. This means that, to set or reset the output, you apply a logic low pulse to the relevant input (rather than a logic high pulse). Our two 556 latches are of this variety.

This month's circuit.

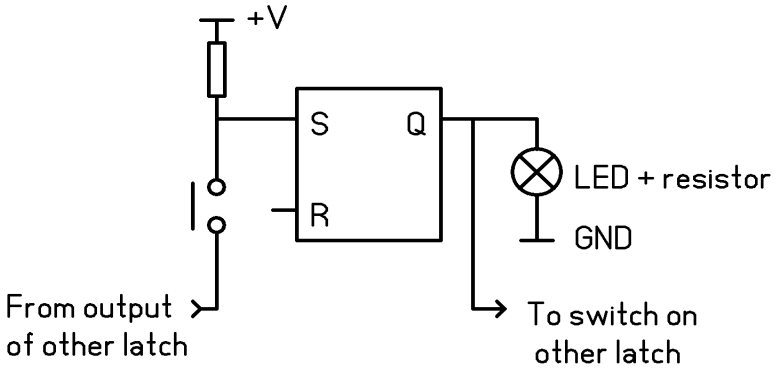
This month's circuit is a simple 'quiz machine' for two players plus a quiz master. Each player has a button which they must press if they wish to answer a question. When they press their button, an LED lights up and the other player is locked-out/prevented from pressing lighting their LED until the quizmaster presses the RESET button (the middle button).

This, of course, all works with the assistance of a pair of latches. When a player presses their button, the latch output is SET to high and the LED attached to the output lights. However, the circuit is set-up so that the contestant can only SET their latch if the other latch is not already set. The block diagram below shows how this achieved (omitting the RESET circuitry and power supply circuitry details).

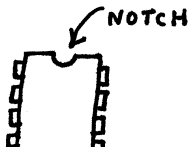
Building the quiz machine.

Note: although I have checked the PCBs carefully, due to a slightly quirky design decision I made, there may be one or two holes that are covered-over by the green 'solder resist'. If this is the case, this thin layer can easily be pierced with a pin or the lead of a component (the sturdy legs of an LED work well for this job)

1. Start by soldering the five resistors in place n.b. they are identical.



2. Solder the 14-pin socket for the IC in place, ensuring that the notch is aligned with the marking on the PCB (i.e. furthest away from the LEDs).



3. The three switches can now be soldered in place. At first glance these may appear to be square but note that the legs actually have a rectangular arrangement and should fit easily into the holes when in the correct orientation.

4. You can now solder the red and green LEDs in place in whichever arrangement you wish but remembering that the long wire should go in the hole marked '+'

5. Attach the battery clip by pushing the wires up through the large holes and down into the holes marked '+' and '-'. The red wire goes to the '+' hole and the black wire goes to the '-' hole.

6. Finally, fit the 556 into the IC holder with the 'notch' aligned with the notch in the IC holder and as indicated on the PCB. The legs on a new IC tend to be spread out a little too far to fit easily into an IC holder so you may need to press them inwards a little before inserting them into the holder (take care: the pins are sharp!). You can do this by pressing a whole row of legs at a time against the tabletop.

You may notice something a little different with this PCB to the other PCBs in the subscription (apart from the colour!). On the previous PCBs the holes were "through-hole plated" and had pads on both sides of the PCB. Whilst this made them easy to solder, it also made them excessively difficulty to desolder, should the need arise. Consequently, with the new batch of PCBs, I've avoided through-hole pads wherever possible. This, I hope, makes them a little more beginner-friendly.