Build our

Quiz-Master

for party fun & games

Here's a gadget you can use to play your own quiz games like those on TV. It "bleeps" and lights a LED to show you which of its three buttons was pressed first — and it can't be fooled. Why not build it up and have fun with your friends?

by GERALD COHN

You can use the gadget described in this article to play one of the quiz-type games like the familiar "Jeopardy" or "It's Academic" on TV. Or you can simply use it to compare the reaction times of you and your friends. Either way, you can use it to have a lot of fun.

It provides three player pushbuttons. After the circuit has been reset, it will indicate which of the three buttons is pressed first, by means of a corresponding light-emitting diode (LED). It then latches itself so that the other two buttons are made insensitive — leaving no doubt as to who pressed their button first! At the same time it produces an electronic "bleep" sound, to announce the winner.

The heart of the project is a small printed circuit board that contains all the decision making electronics. This consists mainly of five low-cost ICs, three of which are of the CMOS type (complementary Metal Oxide Semiconductor), and the other two of the more conventional bipolar type.

We decided to use CMOS type ICs because of the flexibility of their operating voltage range. TTL (Transistor-Transistor Logic) is also capable of doing the same job, but here we require a regulated 5V supply. This poses a problem when one considers that the unit is to operate from batteries. CMOS also provides us with another advantage: lower power consumption, and hence a longer battery life.

The circuit diagram may look a little confusing at first, but it's really fairly straightforward. At the heart of the circuit are three R-S type flipflops, FF1, FF2 and FF3, each made up from a pair of two-input gates. Thus FF1 is made up from gates IC1a and IC1b, FF2 from IC1c and IC1d, and FF3 from IC3b and IC3c. Each flipflop is associated with one of the three player pushbuttons.

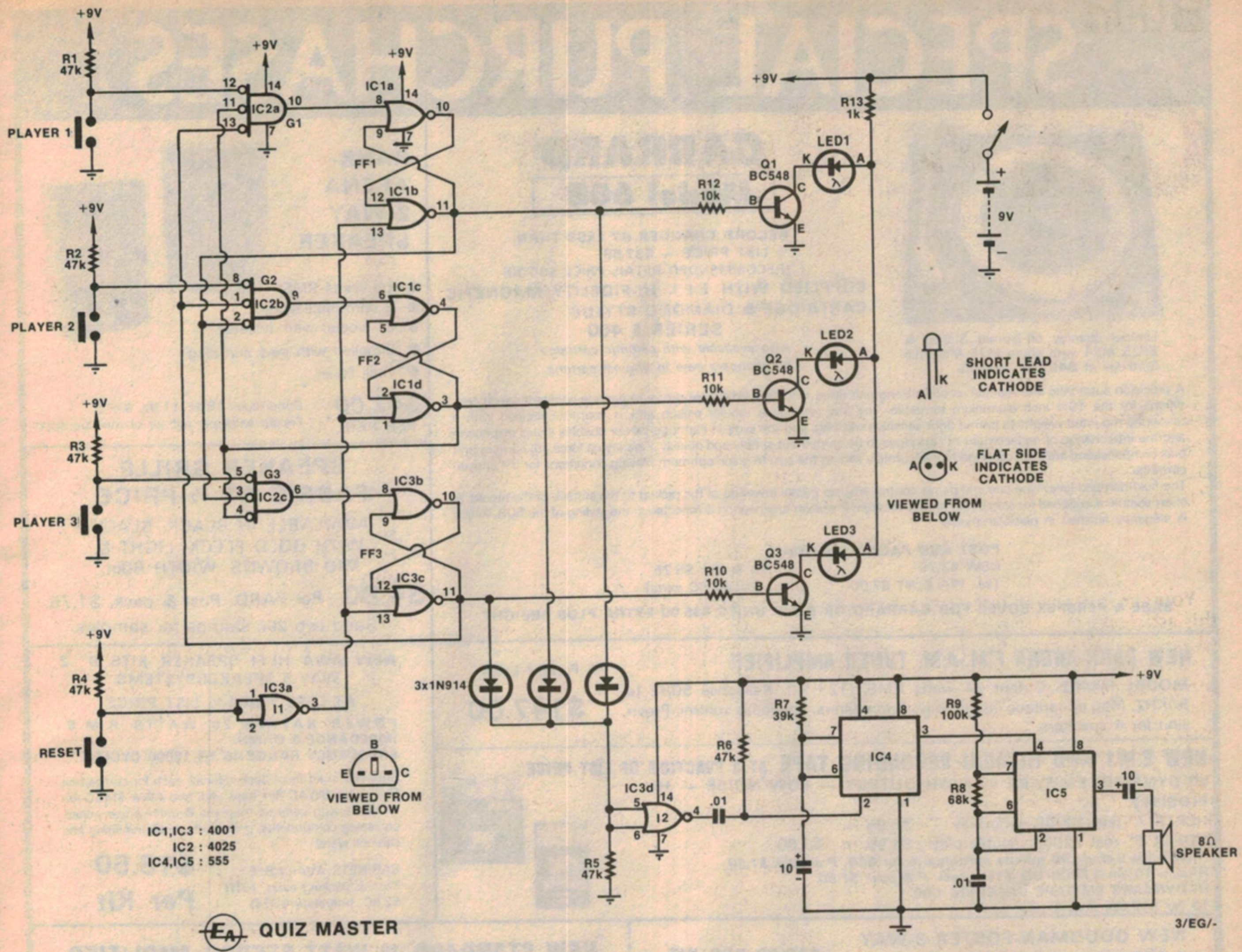
The pushbuttons are not connected directly to the flipflop inputs, but via the three-input gates IC2a, IC2b and IC2c. These gates are shown on the circuit as AND gates responding to negative logic on their inputs, as this is the way they are being used here. (If you are unfamiliar with the idea of logic convention, I suggest you look at the EA handbook "An Introduction to Digital Electronics".)

If you trace through the circuit, you will see that the second and third inputs of each gate are actually connected to the outputs of the two flipflops which correspond to the "other" players. The idea behind this is quite simple: when any of the three flipflops is triggered into the set state, it disables the gates leading to the other two flipflops — and thus prevents them from being triggered. This is how we get the "lockout" action, to ensure that there is only one winner.

The second inputs of each of the three flipflops are tied together, and connected to the output of gate IC3a. This is wired as an inverter, and driven in turn by a fourth pushbutton labelled "RESET". So by pressing this button we are able to force all three flipflops into their reset state, ready for a new game.

Attached to the output of each flipflop is an indicator circuit, consisting of an NPN transistor driving an LED. Thus transistor Q1 and LED1 form the indicator for FF1, Q2 and LED2 the

A front panel LED comes on to indicate which of the three buttons has been pressed first. Plastic film cannisters were used to house the player buttons.



The circuit may look complicated, but it's really very easy to build.

indicator for FF2, and Q3 and LED3 that for FF3.

Also attached to the outputs of the three flipflops are three 1N914 silicon diodes, which together with resistor R5 from a simple OR gate. These feed gate IC3d, wired as an inverter, which in turn drives the "bleeper" circuitry based on IC4 and IC5. These are both 555 timer devices, with IC4 connected as a monostable which determines the length of the "bleep", and IC5 as an astable which generates the bleep itself. As you can see the output of IC5 drives a small loudspeaker.

Confused? Well, let's go through the operation step by step. First of all, the reset button is pressed. This resets all three of the flipflops, so that their outputs are at the "low" logic level. This means that Q1, Q2 and Q3 are all cut off, and their LEDs receive no current. Also none of the three 1N914 diodes can conduct, so IC3d, IC4 and IC5 are all inactive.

Because the three flipflop outputs are all low, the input gates IC2a, IC2b and IC2c each have two inputs low. The only input of each one that is not low is the one connecting to its pushbutton; and in each case there is a 47k resistor (R1-R3) pulling that input high. So all three gates remain inactive — until one of the three buttons is pressed.

As soon as one of the buttons is pressed, things suddenly change. The first thing that happens is that the button which is pressed pulls the third input of its associated gate low, so that all three inputs are finally low. This makes the gate concerned switch its output from the low level to the high level, and as a result it triggers the corresponding flipflop into the "set" state.

The output of this flipflop thus goes high, turning on its corresponding LED via the driver transistor. And at the same time one of the three 1N914 diodes conducts, taking the inputs of IC3d high and causing this element to trigger the "bleeper" circuit. So the winner's LED lights, and the win is announced with a loud bleep.

What also happens is that in going to the high logic level, the output of the winner's flipflop pulls up one input of the input gates for each of the other two players. So about one microsecond after the first button is pressed, the other two buttons are effectively disconnected from their flipflops — or "locked out".

At this stage you're probably still a little vague as to the operation of the bleeper circuitry, around IC4 and IC5. Unfortunately this would take quite a deal of explanation to describe in detail, so we can't take it much further than we have done above. The main thing to note is that IC4 produces a pulse about half a second long, which is then used to turn on IC5 for that time. IC5 operates as an astable or oscillator, producing a square wave of about 600 Hertz. This is fed to the loudspeaker to produce the "bleep". Now that we have discussed the operation of the circuit, let's take a look at the construction of the project.

Most of the components are mounted on a printed circuit board (PCB), which measures 74 x 80mm and is coded 79QM9. The PCB pattern is reproduced here actual size, for the benefit of those who may wish to make their own. However patterns are being sent to the various board makers, so that you should be able to buy ready-made boards shortly.

Before you rush in to start placing components on the PCB and begin soldering, I suggest that you first check the PCB to make sure that it has been properly etched. Some of the things that you should look for when checking the board are continuity of the tracks, (some of them are rather narrow) and/or incomplete etching. You can use the PCB pattern reproduction as a reference against which to check the board.

If you are happy that the board is OK, you can start assembling the unit. The best place to sta:t would be with the wire links. All the links on the board are made using tinned copper wire, and if you don't have this as such, you will find that telephone-type wire with the insulation removed is ideal for this.

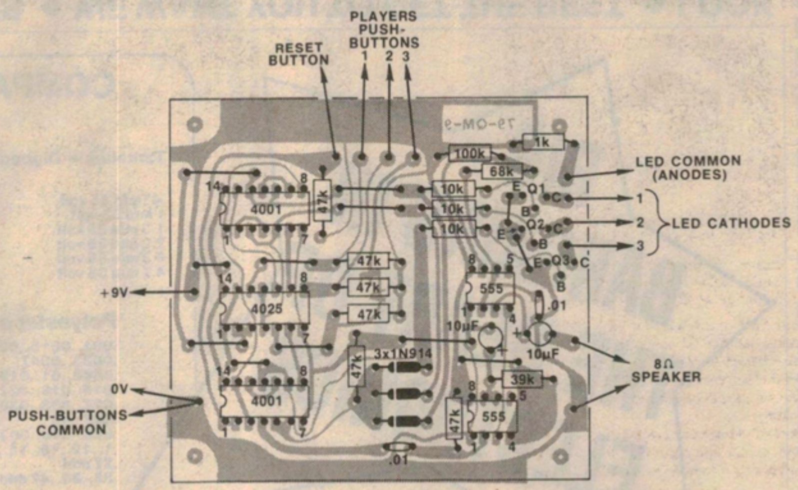
The resistors and capacitors are mounted onto the board after the links have been soldered. Take care when inserting the two tantalum capacitors to ensure that they are correctly placed, since they are polarised components.

The PC pins used for wiring terminations are the next to be mounted on the PCB; followed up by the sockets for the CMOS devices (IC1, 2 and 3). I suggest that sockets are used for the CMOS IC's, since these devices are easily damaged by static discharges, particularly during soldering. A point to note is that CMOS devices must be handled with care if they are not to be damaged. When you pick the IC's up, try not to handle them by the leads; rather pick them up by the ends of the plastic body.

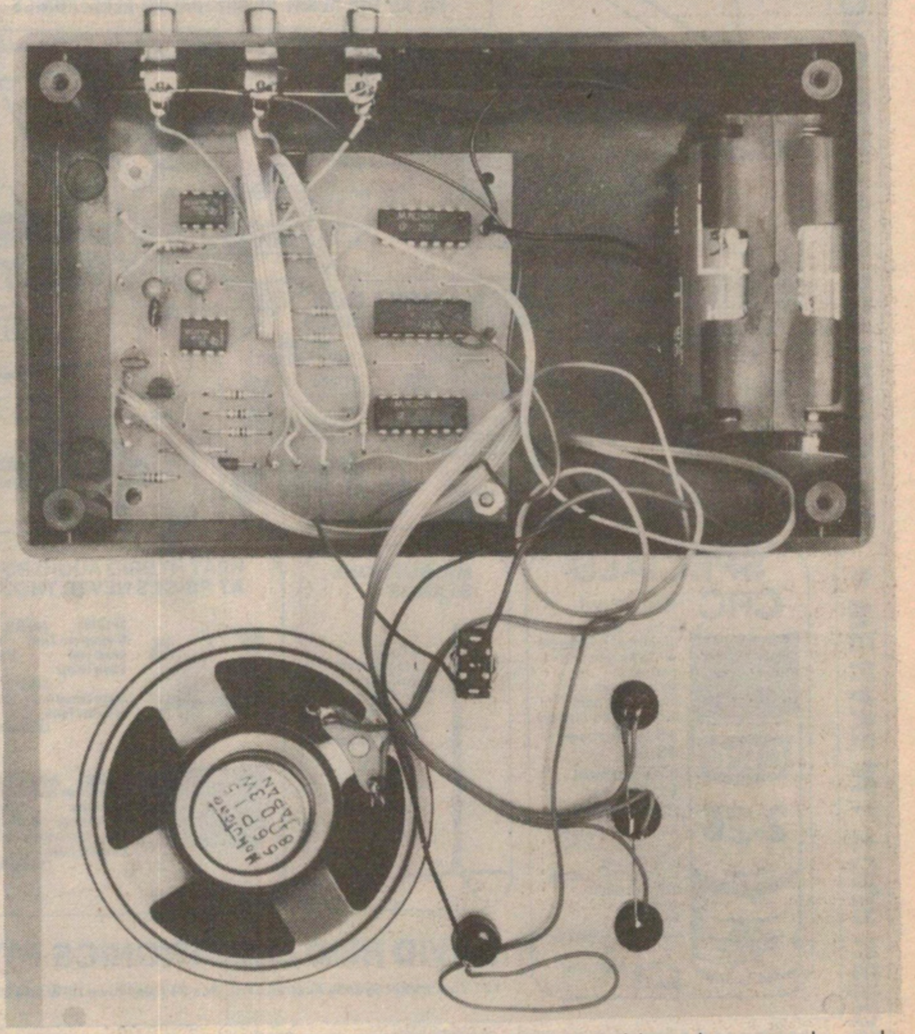
The 555 timer chips can by soldered directly to the printed circuit board, although care must still be taken to ensure that the devices are not subjected to excessive heating. After the 555s come the three diodes and the three transistors. These should be soldered to the PCB using heatsink clips or a pair of long nosed pliers, to protect them from heat while soldering.

The PCB assembly should now be complete, and you can turn your attention to the box that houses all the electronics. We used one of the plastic "Zippy" boxes for our prototype, the dimensions of which are 150 x 90 x 50mm deep. The box is listed in the Dick Smith catalogue as part No. H-2751, but should also be available from other suppliers. It comes supplied complete with an aluminium lid and fixing screws.

The front panel of the box was "dressed" up with a photo etched aluminium panel that was made with "Scotchcal". The artwork for the panel has been reproduced here full size for



Above is the component overlay diagram. The three CMOS ICs (at left) should be mounted last. Below is a view inside the completed prototype, showing the layout of components on the front panel and inside the plastic case.



those who may wish to use it as a guide to making their own. You can, on the other hand, use the artwork as a drilling template, and obtain a "Dyline" transparency of the same from us at EA for a nominal cost of $2.00. Yet again you may be able to buy a ready-made Scotchcal panel, from suppliers such as Radio Despatch Service.

The holes for the speaker are 3mm in diameter, while the other holes, i.e. those for the switch, the reset button, and the three LEDs are 6.5mm in diameter. Another three holes are required in the side of the case for the three sockets into which the players' buttons are connected. We found this to be the best way since it adds a little to the versatility of the unit. The position of the three connectors is not critical, and the photograph should give you some idea of how we placed them.

The pushbuttons for the players were mounted into small plastic film cannisters. The type that we used for the prototype was obtained when we purchased some 35mm Kodak film. The film cannisters were found to be ideal here because they fit quite snugly into the hand, with the thumb being used to activate the button. We fitted the buttons with a five metre length of twin flex, and found this to be suitable for most situations, although they can be made longer or shorter as required.

The speaker was mounted onto the front panel using contact adhesive, and this proved to be quite adequate. When using the adhesive, refer to the directions first, as this type of adhesive has to be used in a special manner if it is to do the job properly.

The printed circuit board is mounted under the speaker, so due allowance must be made for the depth of the speaker. The battery holder is mounted on the other side of the box, right up against the side, and this allows plenty of clearance for the LEDs. The printed circuit board is held in place using some screws with multiple nuts as spacers.

We used RCA-type audio connectors for the player buttons, and these were of the panel mounting type. The solder lugs that are supplied with the sockets were bent over and commoned up with a length of tinned copper wire.

The wiring to the components not mounted on the PCB is a simple task, but one that is best done in a systematic order. The easiest way would be as follows:

- Wire the pushbutton inputs to the sockets (taking note of the order), and take the common to the negative terminal on the board.
- Mount the LEDs onto the front panel and connect them to the LED outputs on the PCB. The anodes of the LEDs are taken to the LED common terminal on the PCB.

The last of the wiring involves hooking up the speaker, the power switch and the battery clip. You may find it desirable to extend the length of the positive lead on the battery clip to allow the lid of the box to come well clear of the rest of the unit if you ever have to open it up.

When you have completed all the wiring, go back and do a check on the complete assembly, making sure that things such as the ICs are in the proper places, and the right way around. The other things that are important are the transistors and the polarised capacitors. If you are happy that all is in order, continue with the testing of the unit.

Testing of the unit is simple and should not take more than about 10 minutes. Start by closing the power switch, noting that there are no LEDs on and that there is no sound coming from the speaker. Should a LED be lit up,

We estimate that the current cost of parts for this project is approximately

$20.00

This includes sales tax.

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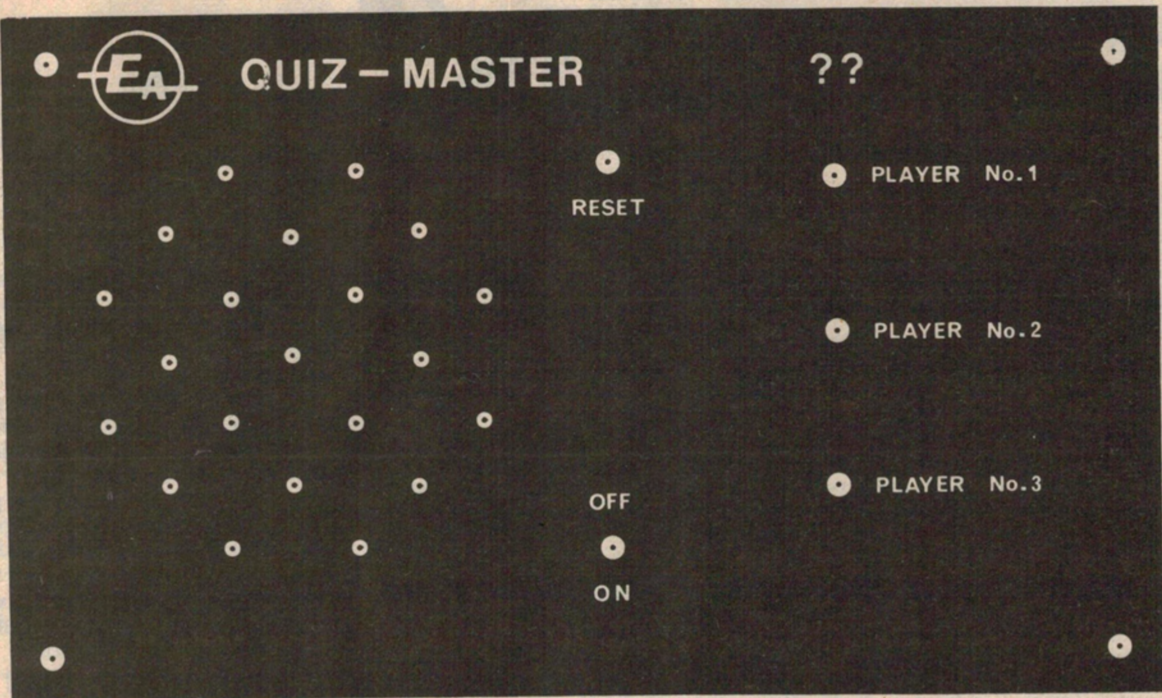
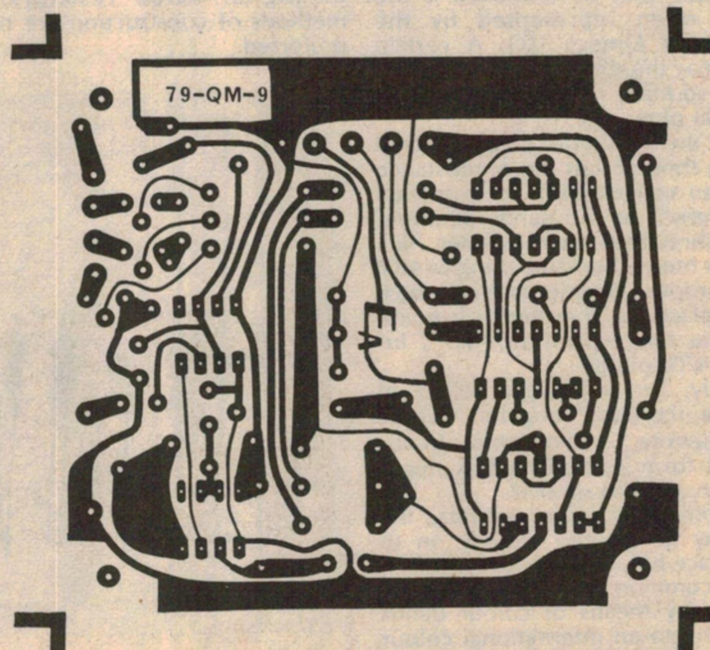


Here are actual size reproductions of the front panel artwork and the PC pattern.



PARTS LIST

SEMICONDUCTORS
- *2 4001 CMOS ICs.*
- *1 4025 CMOS IC*
- *2 555 timer ICs*
- *3 BC548 NPN transistors*
- *3 1N914 diodes*
- *3 red LEDs*

RESISTORS
- *6 47k ¼W 5%*
- *1 1k ¼W 5%*
- *3 10k ¼W 5%*
- *1 39k ¼W 5%*
- *1 68k ¼W 5%*
- *1 100k ¼W 5%*

CAPACITORS
- *2 .01uF LV polyester*
- *2 10uF 25V tantalum*
- *1 1000uF 16V electrolytic*
- *1 printed circuit board code 79QM9*
- *4 momentary contact pushbuttons*
- *3 RCA panel mount audio connector sockets*
- *3 RCA plugs*
- *1 single pole miniature toggle switch*
- *1 miniature eight ohm loudspeaker*
- *1 plastic "zippy box" 150 x 90 x 50mm*

MISCELLANEOUS
Battery clip and holder, wire, solder, screws, nuts, bezels for LEDs, glue etc.

press the reset button and see that the LED goes out.

Now, press the button for the first player. You should see the LED for player No. 1 light up, and you should also be able to hear a tone coming from the speaker, the duration of which should be approximately half a second. Pressing the buttons for players two and three should not have any effect on the unit. Now, press the reset button and the LED should go out. Repeat the same procedure this time with button No. 2, and then finally with button No. 3.

If all the functions appear to work properly, then chances are that nothing is wrong, leaving only one thing to be done: to close up the box. You could also perhaps give yourself a small pat on the back, for another project successfully finished!