

Thursday 21 June 2012 – Afternoon

**GCSE DESIGN AND TECHNOLOGY
Electronics and Control Systems**

A514/01 Technical Aspects of Designing and Making: Electronics

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:

- A calculator may be used

Duration: 1 hour 15 minutes



Candidate forename		Candidate surname	
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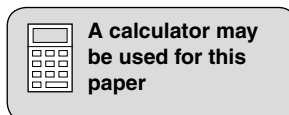
Centre number							Candidate number				
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions in Section A **and** Section B.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Show all your working out for calculations.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- Marks will be awarded for the use of correct conventions.
- Your Quality of Written Communication will be assessed in questions marked with an asterisk (*).
- Dimensions are in millimetres unless stated otherwise.
- This document consists of **16** pages. Any blank pages are indicated.



Section A

Answer **all** questions.

- 1 Fig. 1 shows a digital map measuring device. As the sensor wheel rotates it sends pulses to the integrated circuit which converts the pulses to a measurement that is displayed on the LCD screen.



Fig. 1

- (a) Fig. 2 shows the system reset button which is recessed into the back of the device.



Fig. 2

- (i) State the purpose of the recess.

.....

..... [1]

(ii) Fig. 3 shows a block diagram of the system for the map measuring device.

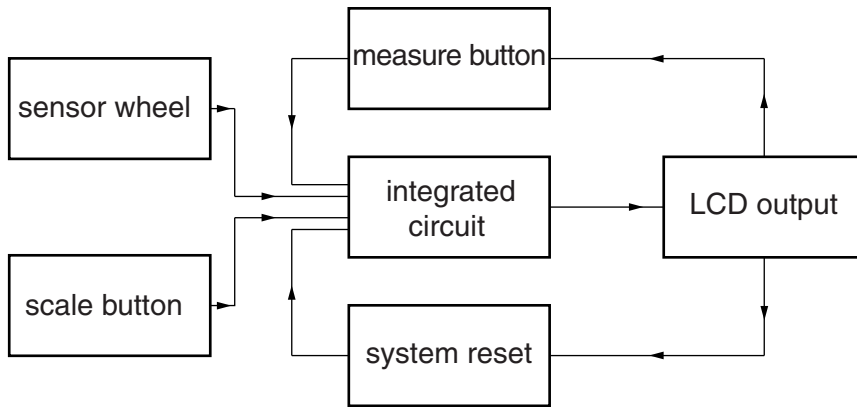


Fig. 3

Give the names of the **two** blocks that are providing feedback in the system.

- 1
- 2 [2]

(iii) The map measuring device uses an LCD display.
Give **one** benefit and **one** drawback of this type of display.

Benefit [1]

Drawback [1]

(b) The circuit board is shown in Fig. 4 with a close up view of the sensor wheel and the two pickups that touch both the sensor wheel and the contacts on the circuit board.

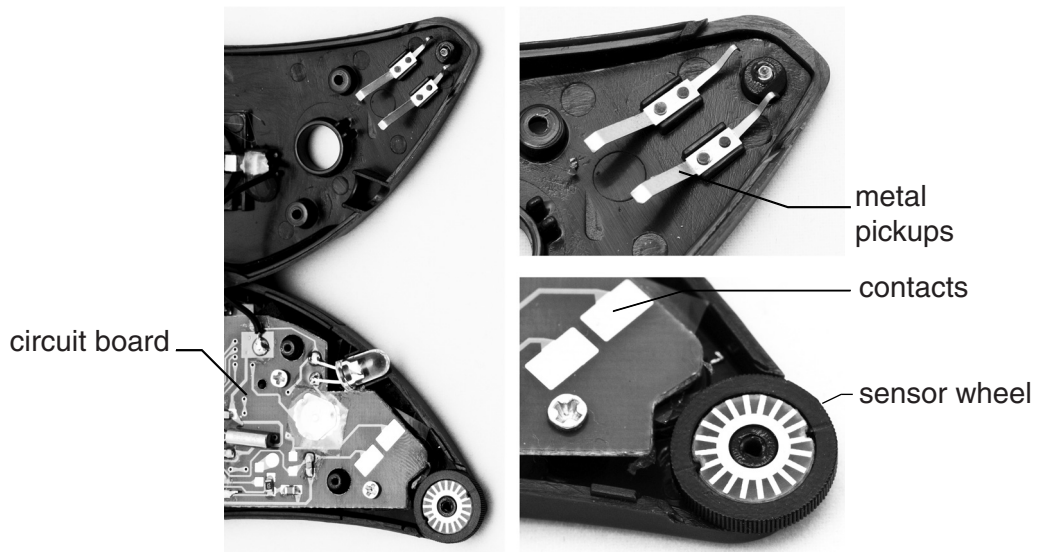


Fig. 4

(i) Describe what will happen as the sensor wheel is rotated.

.....

.....

.....

..... [2]

(ii) Name the type of signal produced by rotating the sensor wheel.

..... [1]

(iii) Name **one** suitable metal for the sensor and pickup surfaces.

..... [1]

(iv) Give **one** reason for your choice of metal.

.....

..... [1]

- (c) An alternative method of sensing is shown in Fig. 5.
The rotating sensor wheel interrupts the beam from the IR LED to the photodiode.

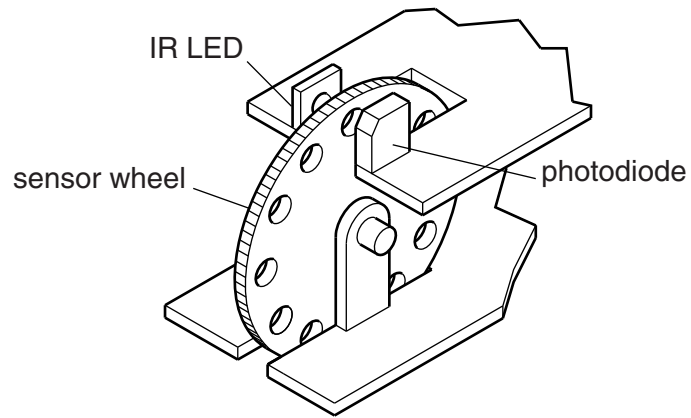


Fig. 5

Explain why this method could be a better choice.

.....

.....

..... [2]

[Total: 12]

2 (a) Fig. 6 shows a multimeter on resistance setting being used to test a newly made PCB.

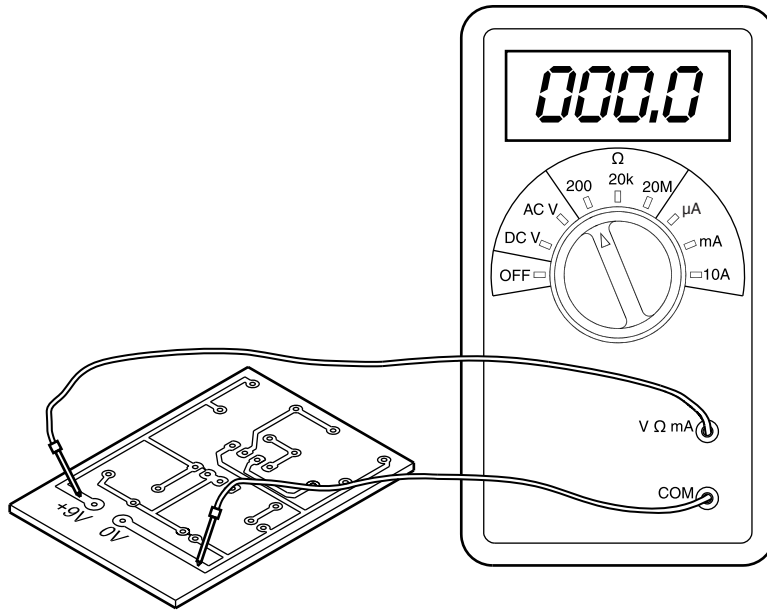


Fig. 6

(i) State the meaning of the reading shown on the multimeter.

.....
 [1]

(ii) Describe **two** possible reasons for this reading occurring on a new PCB.

1

 2
 [2]

(b) Fig. 7 shows three symbols relating to safety that may be found on electronic products. Use words from the list below to complete the symbol descriptions.



.....

Fig. 7

laser hazard

radiation

double insulation

risk of electric shock

kitemark [3]

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- 3 (a) Output stages in a circuit will often need to use a transistor.
Give **one** reason for using a transistor in the output stage of a circuit.

.....
..... [1]

- (b) A Darlington pair arrangement can be used to operate a solenoid.
This arrangement can be made up from two separate transistors.

- (i) Complete the transistor connections in Fig. 8 to make a Darlington pair.

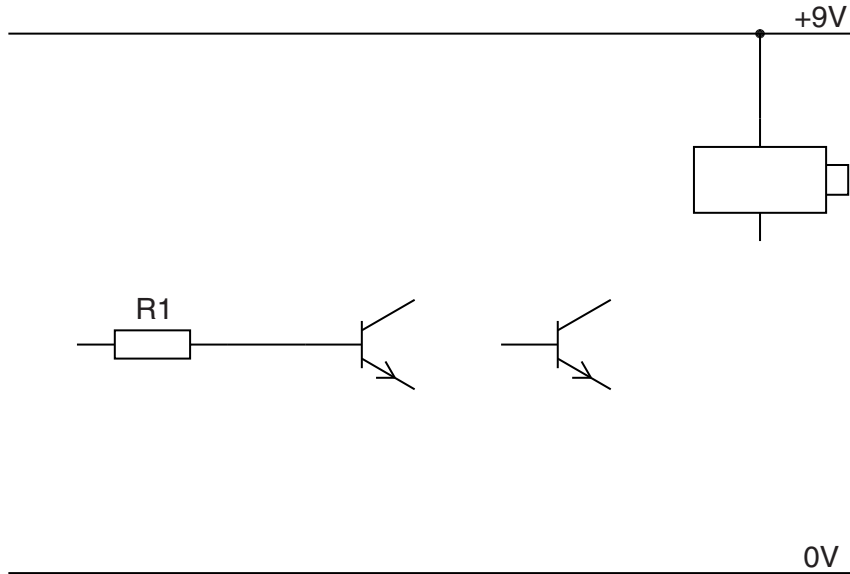


Fig. 8 [3]

- (ii) A protective diode will be needed to prevent damage to the transistor from back emf.
Draw the protective diode on the circuit in Fig. 8. [2]
- (iii) Fig. 9 shows a Darlington pair built into a single transistor.
Use the pinout diagram to label the transistor connections.

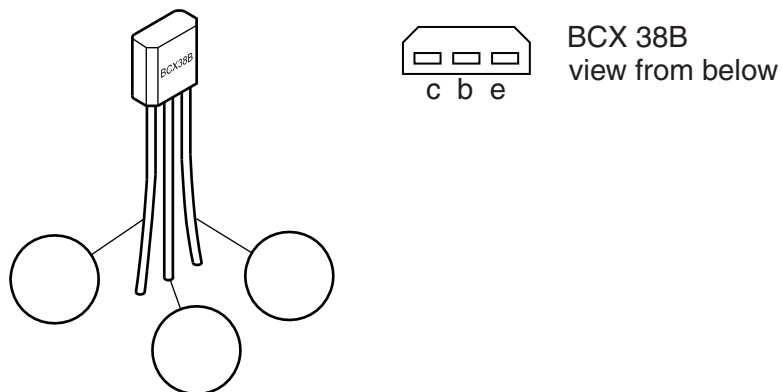


Fig. 9 [2]

- (c) PCBs will often have component positions marked to help with assembly. Fig. 10 shows two ways that a transistor position could be shown. Draw a circle around the better method for batch production work and give **two** advantages for your choice.

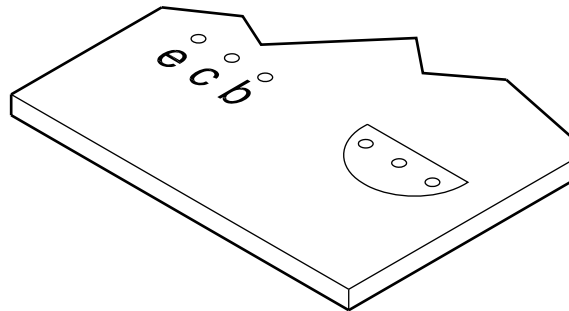


Fig. 10

1

.....

2

..... [2]

- (d) Transistors being developed using nanotechnology will be up to fifty times more energy efficient than transistors currently in use. Describe the potential benefits of these transistors if they are applied to existing electronic products.

.....

.....

.....

..... [2]

[Total: 12]

Section B

Answer **all** questions.

- 4 (a) Fig. 11 shows a product enclosure with a hole for a sensor cable next to the circuit board. Use sketches and notes on Fig. 11 to show how the sensor cable can be securely connected. [2]

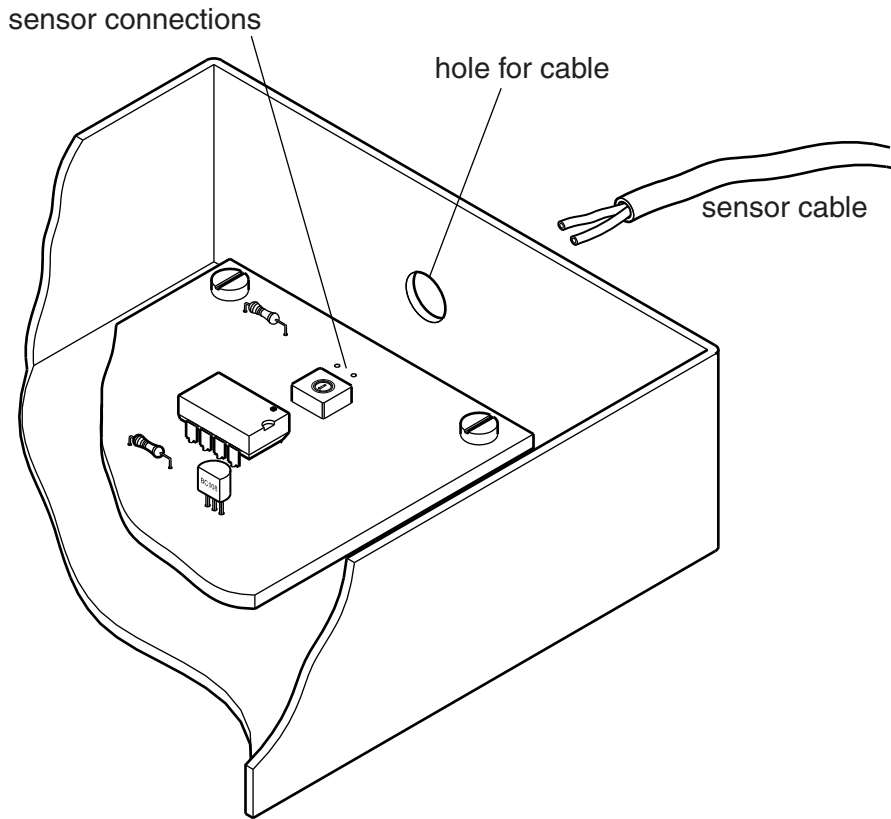


Fig. 11

- (b) The battery will be attached to the product using the battery connector shown in Fig. 12. Using this connector it is possible to touch the connector onto the battery the wrong way around. Complete the battery connections adding a component to the circuit diagram that will overcome this problem.

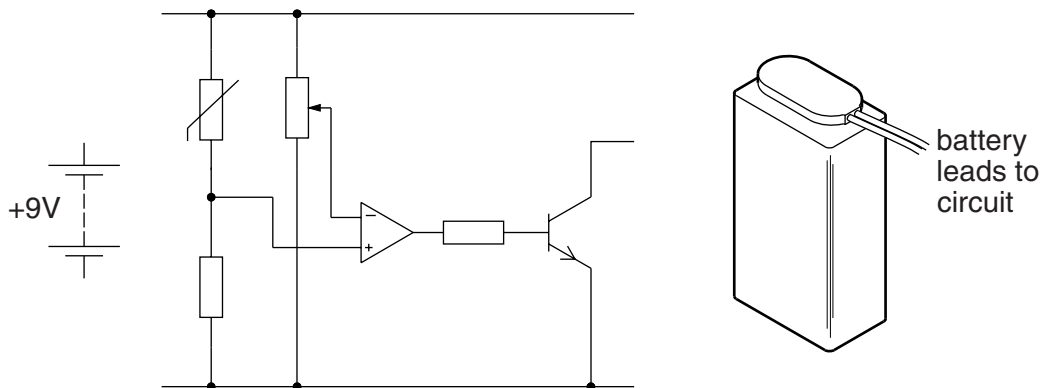


Fig. 12

[2]

Turn over

(c) Multicolour ribbon cable is often used to make connections in a circuit using the plug and socket system shown in Fig. 13.

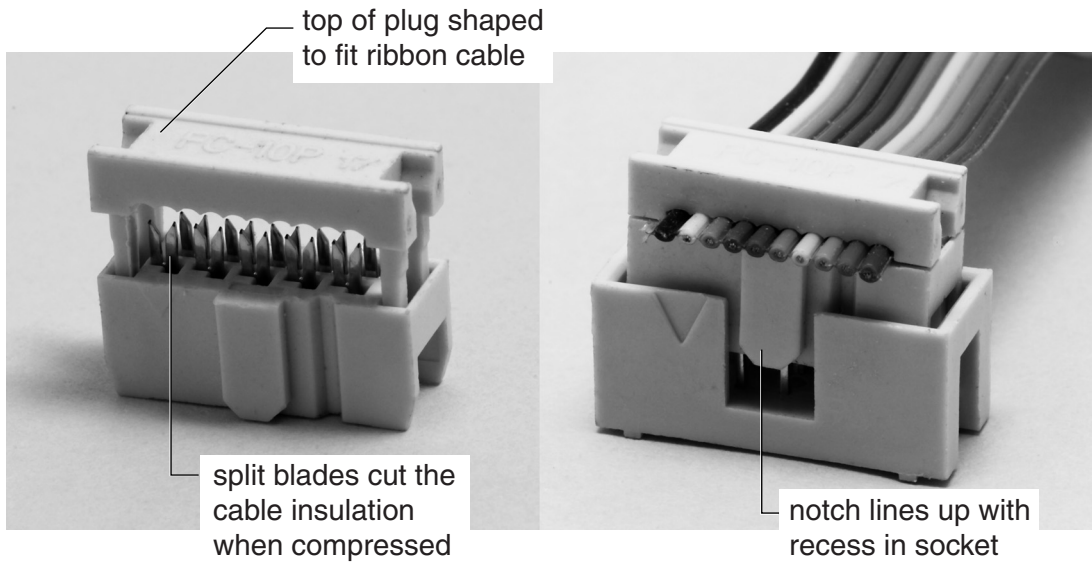


Fig. 13

Give **two** instructions that the designer should give to a person assembling the ribbon cable and plug.

1

.....

.....

2

.....

..... [2]

5 (a) A handheld tally counter is needed to count passengers in a small pleasure boat. The tally counter will use two counter ICs and will have an LED display as the output.

(i) State the maximum number that can be shown on a two digit LED display.

..... [1]

(ii) The operator of the tally counter will press a push to make switch to add to the count. The switch signal will need to be debounced before entering the counter. Give the reason for debouncing the signal from the switch.

.....

..... [1]

(iii) Fig. 14 shows the debouncing circuit with a test LED and a breadboard used to test the circuit.

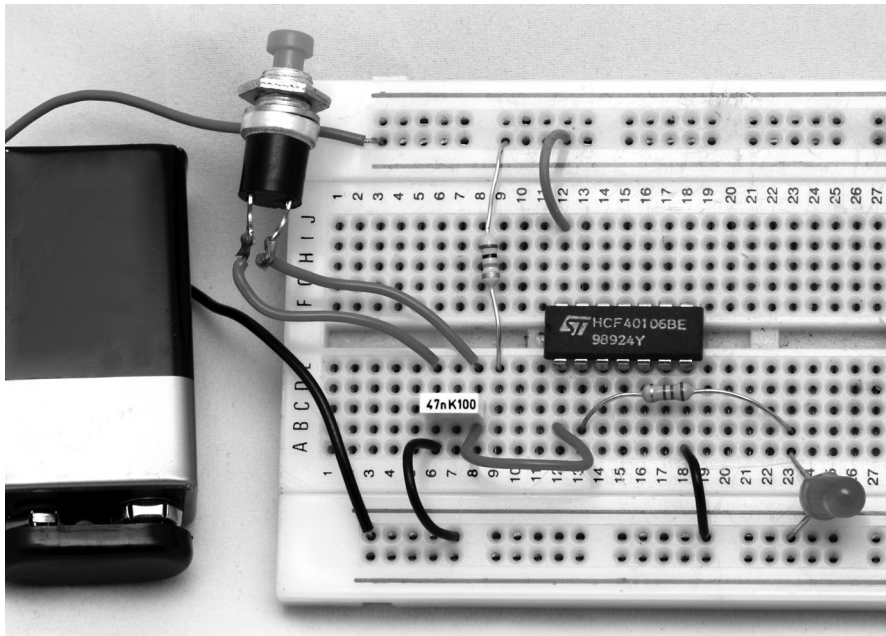
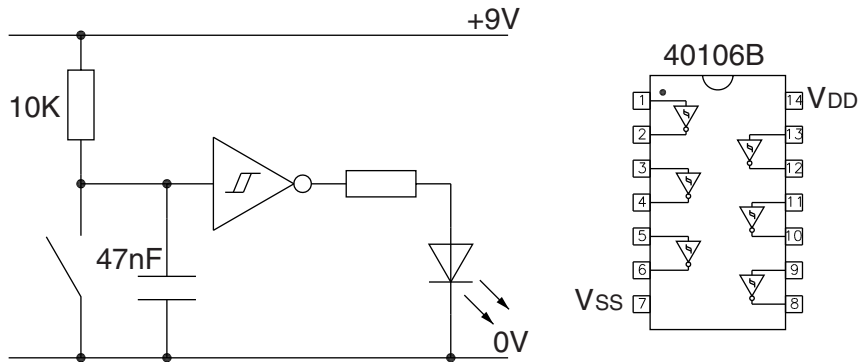


Fig. 14

There are **two** errors in the breadboard. Identify each error.

1

2 [2]

(b) An incomplete PCB layout of the debouncing circuit is shown in Fig. 15.

(i) Add pads and tracks for the 10K resistor and the 47 nF capacitor to the layout.

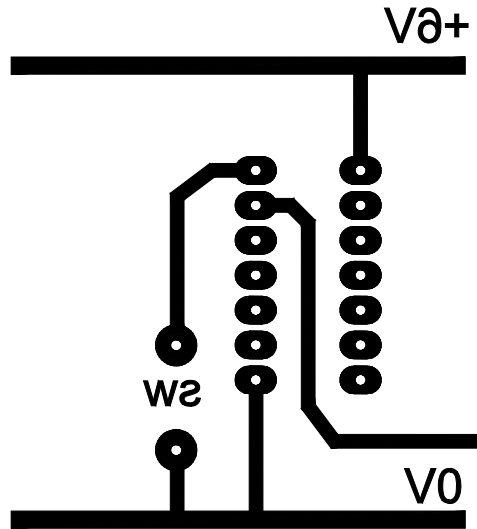


Fig. 15

[2]

(ii) Pin 1 on the IC should be indicated on the layout. Add a suitable indicator for pin 1 that will help when fitting an IC to the circuit. [1]

(iii) When designing a PCB layout it is good practice to make the tracks as wide as possible. Give **two** benefits of increasing the track width on a layout.

1

2 [2]

(c) Fig. 16 shows a CAD simulation of the circuit for the counter ICs.

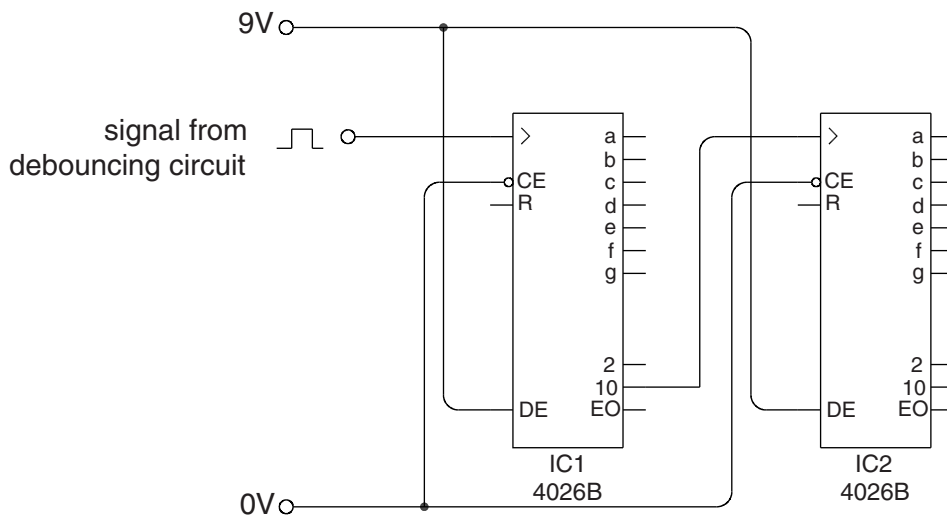


Fig. 16

A reset switch is needed to reset both counters at the same time. The reset pins should be normally low and go high when the reset switch is pressed. Add the reset connections to Fig. 16.

[3]

[Total: 12]

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