



## 4<sup>TH</sup> NATIONAL ABILYMPICS – 2014 CHANDIGARH

VOCATIONAL SKILLS CONTEST

ABOVE 15 YRS.

### V15 – ELECTRONIC ASSEMBLY AND TESTING

#### 1. OBJECTIVE

To judge competitor's skills, knowledge and competence in assembling and testing of an electronic gadget.

#### 2. TASK

The aim is to assemble the hardware components and make wiring connections of *Stepper Motor Control using Microcontroller* (Figure 1 & 2) as per the guidelines given in section 4. Figure 1 and 2 shows block diagram and circuit diagram of stepper motor control task respectively. Figure 3 and 4 shows PCB and component layout of the circuit. Candidates are required to position the PCB, transformer, switches/indicators and motor as per displayed sample. (A sample will be displayed for guidance.)

#### 3. SPECIAL INSTRUCTIONS

- i. Contestants should confirm that the items, quantities, etc. of the provided materials are those specified in Section 5.
- ii. If any wires or parts are damaged or short, the relevant contestant should notify the judge.
- iii. Contestants must make sure that they do not create flaws on the surface of the chassis, printed circuit board etc.
- iv. Contestants must notify the judge when they finish the task.
- v. When the contest is finished, contestants should clean the worktable, etc. following the instructions given by the judge.

#### 4. TASK

The contestants are required to perform the task as per detailed instructions given:

- i Assembly of Components on the Box
- ii Wiring of the system
- iii Show functionality of the system.

## **i Assembly of Components on the Box**

- ❖ The contestants are required to mount the following parts on the chassis
  - a. Soldering of missing components of Board
  - b. Mounting of Board in given box at provided space
  - c. Mounting of switches/indicators in the box
  - d. Mounting of stepper motor in given box at provided space
  - e. Mounting of transformer in given box at provided space
  - f. Connecting transformer with bridge rectifier
  - g. Connection of stepper motor with supply as per given color code
  - h. Mounting of switch/indicator(SW1) and connection
  - i. Fitting of power cord with transformer input

The above Items shall be mounted in the given assembly box. All screws shall be tightened sufficiently to ensure that they do not become loose and damaged.

## **ii. Wiring instructions**

- ❖ Wiring should be done based on instructions given below:
  - a) Green wire should be used for ground purposes
  - b) Red wire should be used for live (+) connection
  - c) Black wire should be used for neutral (-) connection
  - d) Use the color code for motor connection as per circuit diagram of Figure (2).

## **iii Showing the Functionality of the System**

- ❖ The functionality of the system will be tested by plugging in the input cable of the transformer to the mains.
- ❖ When power supply switch S1 is closed, LED1 glows to indicate the presence of power in the circuit.
- ❖ When transistors conduct, 5V (Vcc) is applied to the coils and the currents flowing through them create magnetic fields and the motor starts rotating.
- ❖ When the switch S3 is opened the motor rotates in clockwise direction, and when this switch is closed the motor rotates in anti-clockwise direction.
- ❖ For anti-clockwise rotation of the motor, reset switch S2 is to be pressed momentarily after S3 is closed (Figure 3). In case you observe an abnormal motion of the motor either in clockwise or anticlockwise direction, pressing reset switch S2 momentarily will make the motor run smoothly.

## **iv Design calculations to be done by the contestant**

The speed of the stepper motor is proportional to the frequency of the input pulses or it is inversely proportional to the time delay between pulses. The relation between step size, speed and pulse frequency is given as:

$$N (\text{No. Steps per Revolution}) = 360 / d (\text{Motor Step Angle})$$

$$S (\text{Speed per min}) = F (\text{Frequency}) \times 60 / N$$

OR

$$S = 60 F \times d / 360$$

Where S is speed of stepper motor in rpm, F is the frequency of input pulses and 'd' is full step size in degrees. For a step size of  $0.72^\circ$ , and a frequency of 2 kHz, the speed will be 240 rpm.

One-step rotation of the stepper motor used in this project equals  $1.8^\circ$ .

*Candidates will be asked to do simple calculations based on these relations.*

## 5. WORK ENVIRONMENT

- a. Table with Electric outlets (220V AC)
- b. Electric Soldering Iron
- c. Cold Solder and soldering flux
- d. Chair / Stool
- e. Multimeter capable of measuring Voltage, Current, Resistance and Continuity.

## 6. MATERIALS

- a. Cutting pliers
- b. Nose Plier / Tweezer
- c. Screw Driver Set
- d. Parts required for assembly of the Stepper motor control task:
  - i. Box with holding arrangement of components/devices
  - ii. PCB
  - iii. Wires of different colors
  - iv. Major components:

*Semiconductors:*  
IC1 - 7805 5V regulator  
IC2 - AT89C51 microcontroller  
T1, T3, T5, T7 - BC548 npn transistors  
T2, T4, T6, T8 - SL100 npn transistors  
D1-D8 - 1N4001 rectifier diodes  
LED1 - Red LED (5mm dia.)

*Resistors (all 1/4-watt,  $\pm 5\%$  carbon):*  
R1 - 100-ohm  
R2 - 10-kilo-ohm  
R3, R5, R7, R9 - 1-kilo-ohm  
R4, R6, R8, R10 - 470-ohm

*Capacitors:*

C1 - 220 $\mu$ F, 25V electrolytic

C2 - 100 $\mu$ F, 16V electrolytic

C3 - 10 $\mu$ F, 16V electrolytic

C4, C5 - 33pF ceramic disk

C6 - 100 $\mu$ F, 16V electrolytic

*Miscellaneous:*

X1 - 230VAC primary to 0-7.5V,

1A secondary step-down

Transformer

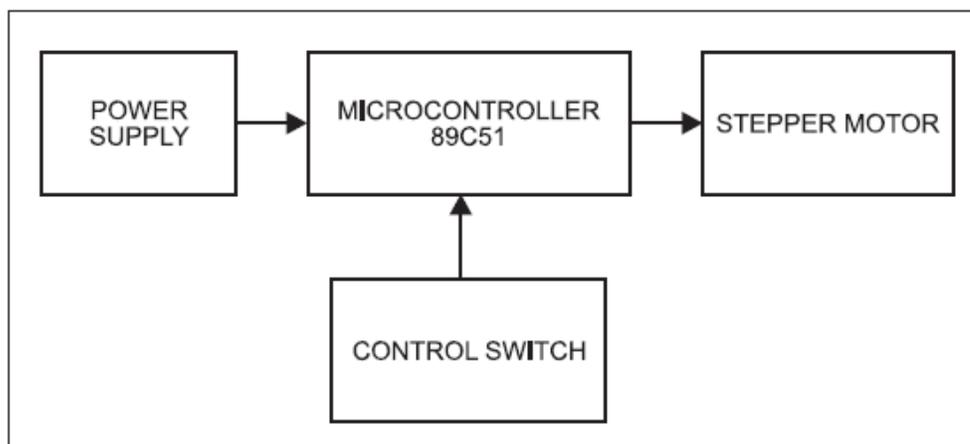
5V DC stepper motor

7. **ALLOCATED TIME**

Maximum time 3 hrs.

8. **EVALUATION CRITERIA**

<b>Items to be Evaluated</b>	<b>Maximum Marks</b>
Fitting of components/parts	25
Wiring layout	15
Soldering Quality	20
Functionality of the system	40
<b>TOTAL</b>	<b>100</b>



*Fig. 1: Block diagram of the stepper motor control system*

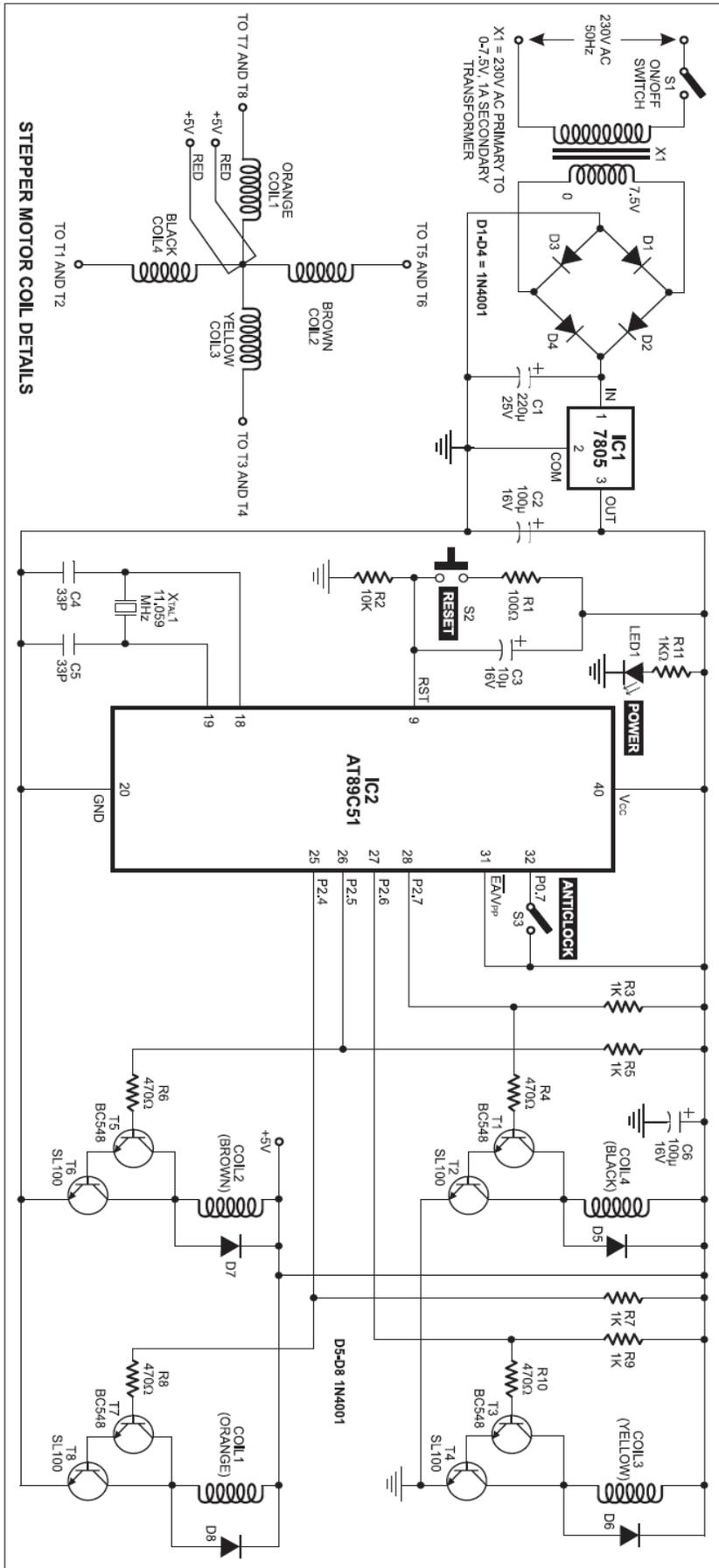


Fig. 2: Circuit Diagram

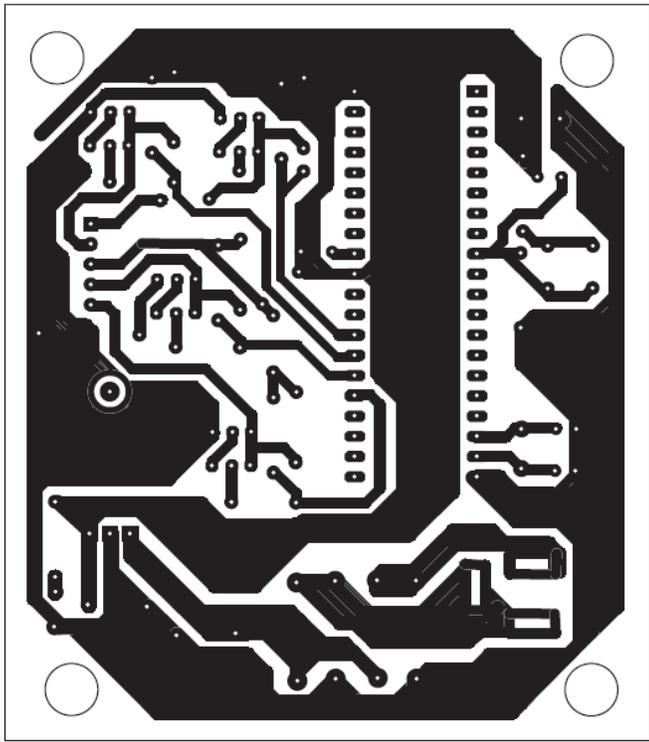


Fig 3. PCB for stepper motor control

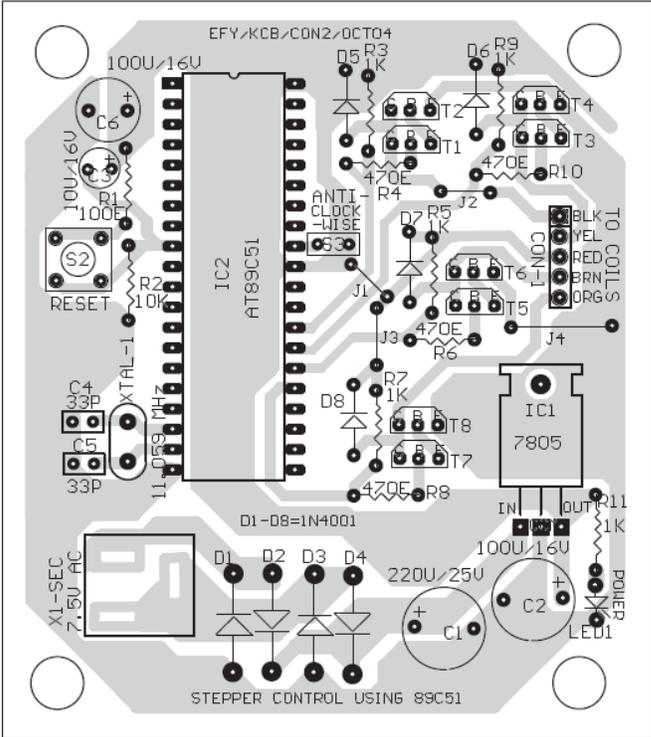


Fig. 4: Components layout