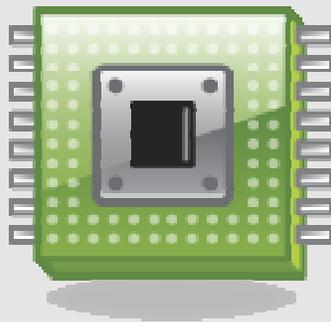


# **GENERAL INSTRUCTIONS**



**STATE  
ELECTRONICS TECHNOLOGY**  
Ver 1.1 03.07.2012

## **INSTRUCTIONS**

**OPEN THIS BOOKLET IMMEDIATELY  
AND READ THE INSTRUCTIONS  
THOROUGHLY.**

## SAFETY INSTRUCTIONS

You ***MUST*** wear eye protection WITH SIDE SHIELDS when soldering, stripping, or cutting wire or component leads. Use caution when clipping component leads to reduce the risk of injury to yourself and others. You must also use your ESD wrist strap and work mat. Failure to wear your eye protection and use static protection as required may reduce your contest score by up to 10 points.

## CONTEST DESCRIPTION

The contest consists of FIVE (5) parts. You will have a specific time to finish each part. When time is called, you should *immediately* stop and wait for a Judge to collect your work. Failure to stop immediately may result in disqualification, at the Judges' option. **Highlighted items will be taken on-line prior to coming to the conference.**

### **PART ONE, WRITTEN PDP TEST** **Tie Breaker** **15 Minutes**

You will be required to complete a TWENTY question, multiple-choice test covering SkillsUSA knowledge.

### **PART TWO, WRITTEN TECHNICAL TEST** **25 PERCENT** **1 HOUR**

You will be required to complete a FIFTY question, multiple-choice test covering aspects of several electronic-related occupations.

### **PART THREE, BREADBOARDING** **25 PERCENT** **2 HOURS**

(See Breadboarding Standards, attached) You will be required to construct a functioning circuit given the necessary components and the schematic, troubleshoot any problems which may appear, and demonstrate the functioning circuit to a Judge. You will be judged on the criteria listed on the sheet attached and whether or not the completed circuit functions properly. Contestants should be prepared to troubleshoot and repair the breadboarding circuit. Faults may include failed components. A copy of the tally sheet which judges will use to grade your project will be included so you can see how you will be judged.

### **PART FOUR, KIT BUILDING** **25 PERCENT** **1.5 HOURS**

(See Soldering Standards, attached) You will be required to prepare components and a printed circuit board for soldering, solder components to a commercial printed circuit board following manufacturer's instructions, trim the component leads, clean the residue from soldering, and demonstrate the functionality of the circuit. You will be graded on the overall craftsmanship used in the construction including neatness, how component leads are cleaned and bent, component layout and clearance from PC board, amount of solder used, quality of connection, board cleaned after soldering, neatness of lead trimming, ability to work non-destructively, and consistent placement, spacing and orientation of components. You will also be graded on whether or not the kit functions when completed. Contestants should be prepared to troubleshoot and repair the circuit. Faults may include failed components and/or circuit boards. A copy of the tally sheet

which judges will use to grade your project will be included so you can see how you will be judged. The PACE soldering standards will be used as judging criteria.

**PART FIVE, OSCILLOSCOPE USE****25 PERCENT****1 HOUR**

You will be required to take specific readings from a test fixture using an industry standard oscilloscope. You will **NOT** be allowed to use cursor measuring or AUTO-SETUP features of the scope. You will be graded on accuracy of your readings and demonstration of your understanding of oscilloscope operation and proper techniques.

**TIE BREAKERS:** In the event of a tie, the tie will be broken by the high score on the following: (in order) PDP test, written test, breadboard skill, kit building skill, and oscilloscope use.

**GENERAL INSTRUCTIONS**

1. You should read the instructions on the front of each section of the contest carefully. Wait until the judges tell you to begin. Further instructions are inside each test. Read these carefully, all the way through, before beginning.
2. Make sure you have completed all parts of each section before stopping. It never hurts to read the instructions again after you have finished to see if you remember doing everything.
3. Since mistakes in industry cost money, you will always be encouraged to check your work before applying power or sending it on as finished. High quality takes a little longer, but pays off in the long run. SkillsUSA-VICA stresses high quality. For these reasons, if you accidentally burn out a component during testing of your circuit, you will not be allowed to replace it with another component. If you complete your circuit and it doesn't work, ask the judge to help verify your wiring **before you change anything**. If the judge can verify that you were issued a bad component and your wiring is correct, you will be allowed to substitute a good component.
4. **Judges devote their time and, in many cases, money to see that the contest is successful.** While every effort is made before the contest to see that all contingencies are covered, some still may occur. That is why **the judges' decisions, in all cases, are final.**
5. Please follow all rules of the contest. You are all here in a spirit of **honest** competition. If you observe a contestant breaking a rule, please bring the infraction to the attention of a judge immediately. They cannot be everywhere at once. You may file a grievance after the contest if you feel something is out of order, but in most cases, to be effective, the infraction must have been brought to the attention of the judges during the contest. They will usually take action immediately to correct the situation.
6. **We all want to have a good time, play fair, and go home happy.**
7. **If you compete fairly, honestly, and give it your best shot, you are a winner.**

## BREADBOARDING STANDARDS

Use the following steps and procedures when breadboarding circuits. HOWEVER, you must make a judgment call between how much time you spend on neatness, and how much time you spend getting the circuit functioning correctly. Recommendation: lay out components neatly, then connect with jumper wires as quickly as possible. When circuit works, go back and route jumper wires, shortening and re-routing where necessary, using the balance of your time to improve neatness.

1. Place components on the breadboard in a visually pleasing manner, as closely as possible to the layout on the schematic. This makes troubleshooting easier for you and for the judges.
2. Trim leads of components so that components rest on or near the surface of the board. You may connect the leads of components (resistors, capacitors, diodes, transistors) to other components, power and ground. Use jumpers to connect components to other components, power or ground if the leads of the components will extend more than 1/8 inch from the body of the components. This eliminates possible short circuits between bare leads.
3. Leaded components (resistor, capacitors, diodes) should be mounted either vertically or horizontally (not diagonally), and oriented in a consistent direction (i.e., with the first band of the color code, anode, or cathode at the top or on the left). Transistors should each be mounted into three consecutive rows (or every other row) with the collector at the top, base in the center, and emitter at the bottom.
4. Axial component leads should be bent in a rounded 90% turn (see comment on bending jumper leads) and be inserted straight down into the board, not angled out or in.
5. IC's should be aligned in a row where possible, with pin one on each chip at the upper left position.
6. Strip approximately 1/4" of insulation from jumper wires (never more than 5/16" nor less than 3/16") so as to allow as little bare wire to show between the insulation of the wire and the breadboard socket as possible, in no case should more than 1/8" of bare wire be exposed out of the breadboard socket. If prestripped wires are used, use the shortest wire that will make the connection. Neatly bend the excess out of the way or cut the wire and strip to an exact fit.
7. Jumper wires should be placed as flat and as close to the breadboard as possible, running parallel to each other and not crossing any more than necessary.
8. Jumper wires should be run neatly beside and between components, as straight and as short as possible. Do not use excessively long wires when short ones will do. Excessive wire causes electrical problems and makes troubleshooting more difficult.
9. Bends in jumper wires should be slightly rounded, to avoid stressing wire or insulation, but as tight as possible. Technically, minimum bend radius should be 1.5 times the wire diameter (National Electrical Code, 1999, National Fire Protection Association).
10. NEVER cross components with jumper wires. Routing wires around components simplifies measuring voltages at component leads and removing components for testing or replacement.

## SOLDERING STANDARDS

The following information is excerpted from ANSI/J-STD-001, the Joint Industry Standard for **Requirements for Soldered Electrical and Electronic Assemblies**. This standard is quite extensive and covers processes and materials not used in contest, so only pertinent materials have been duplicated below. These are relevant only to Class 1: *General Electronic Products*, defined as: "...consumer products, some computer and computer peripherals, and hardware suitable for applications where the major requirement is function of the completed assembly." See the diagram on page 7 for illustration of the following principles.

- 6.2.4 Wire and Cable Preparation** Sufficient insulation shall be stripped from the wire or leads to provide for insulation clearances as specified. ....After insulation removal, deformation of remaining insulation shall not exceed 20% of the insulation thickness. In stripping insulation, care should be taken to avoid nicking or otherwise damaging the wire or the remaining insulation. For Class 1 assemblies, the number of damaged or severed strands in a single wire shall not exceed the following: 0 for 7 or fewer strands; 1 for 7-15 strands; 2 for 16-18 strands; 3 for 19-25 strands, 4 for 26-36 strands; 5 for 37-40 strands; 6 for 41 or more strands.
- 6.4.6 Insulation Clearance** The clearance between the end of the wire insulation and the solder of the connection shall be as follows: **Minimum:** The insulation may be in contact with the solder joint but not be covered by solder. The contour of the wires shall not be obscured at the termination of the insulation. **Maximum:** Clearance shall be less than two wire diameters including insulation or 1.5 mm, whichever is larger, but shall not permit shorting between adjacent conductors.
- 6.6.3 Lead Forming Requirements** Leads must extend from the body for at least one lead diameter or thickness but not less than 0.8 mm prior to forming bend.
- 6.6.4 Lead Termination Requirements:**
- 6.6.4.4 Straight Through Lead Termination** Component leads terminated straight through shall project a maximum of 1.5 mm from the conductor surface, and as a minimum be discernible in the completed solder connection.
- 6.6.5 Component Body Positioning:**
- 6.6.5.1 Meniscus Spacing & Trimming** Components shall be mounted to provide a visible clearance between the coating meniscus [the cone shaped point of insulating coating where the component leads stick out of the component coating] on each lead and the solder connection. Trimming of the component coating meniscus is prohibited.
- 7.1 General:**
- 7.1.5 Heat Application** The elements to be soldered must be sufficiently heated to cause complete melting of the solder and wetting of the surfaces to be soldered.
- 7.1.6 Cooling** The connection must not be subjected to detrimental movement or detrimental stress at any time during the solidification of the solder.
- 7.1.7 Lead Trimming** Leads may be trimmed after soldering provided the cutters do not damage the component due to physical shock. When lead cutting is performed after soldering, the solder terminations shall be reflowed. This reflow is not considered a rework.

- 7.2.2 Solder Application** A well-tinned tip shall be applied to the joint and the solder introduced at the junction of the tip and the connection for maximum heat transfer. After applying heat and achieving heat transfer, the solder should be applied to the joint and not the soldering iron tip.
- 9.2.4 Solder Connection** The acceptable solder connection must indicate evidence of wetting and adherence when the solder blends to the soldered surface, forming a contact angle of 90° or less. The solder joints must have a generally smooth appearance. A satin luster is permissible. Smooth clean voids or unevenness on the surface of the solder fillet or solder coating are acceptable.
- 9.2.4.1 Marks and Scratches** Marks or scratches in the solder joint shall not degrade the integrity of the connection.
- 9.2.5.3 Exposed Basis Metal** Incomplete solder wetting at the tip of through-hole component leads and edges of printed board lands and conductors is acceptable. Exposed basis metal caused by cutting of component leads after soldering is permissible.

#### **Appendix D: Placement Requirements for Through-Hole Mount Devices**

- D-1 Horizontal Mounting--Freestanding** When components are mounted freestanding, the spacing between the body of the component or end of meniscus (if present) and the surface of the board shall, as a maximum, be 2.0 mm.
- D-2 Axial Leaded Components** Axial-leaded parts shall be mounted as specified on the approved assembly drawing and mounted approximately parallel to the board surface, or perpendicular as specified. Bodies of axial-leaded parts should be approximately centered.
- D-3 Radial Leaded Components** Radial leaded components should be mounted parallel to the surface of the printed board within the spacing tolerances specified above in D-1.
- D-4 Perpendicular Mounting--Freestanding** The spacing requirements for freestanding, perpendicular mounted parts shall be the same as those for horizontal mounting (see D-1 above).
- D-4.1** Unless otherwise noted on the assembly drawing, through-hole components required to be perpendicularly mounted should be installed with their major axis approximately 90° to the board surface and with a minimum of 0.4 mm between the component body (seal or lead weld) and the board surface.
- D-4.2 Radial Leaded Components** When dual lead components are mounted free standing, the larger sides shall be perpendicular to the board surface 15°.

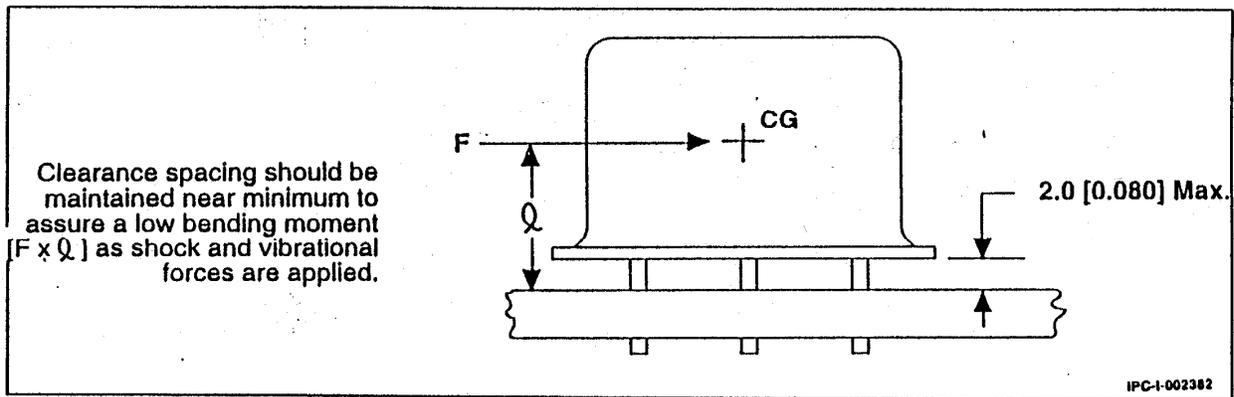


Figure D-1 Mounting of freestanding components

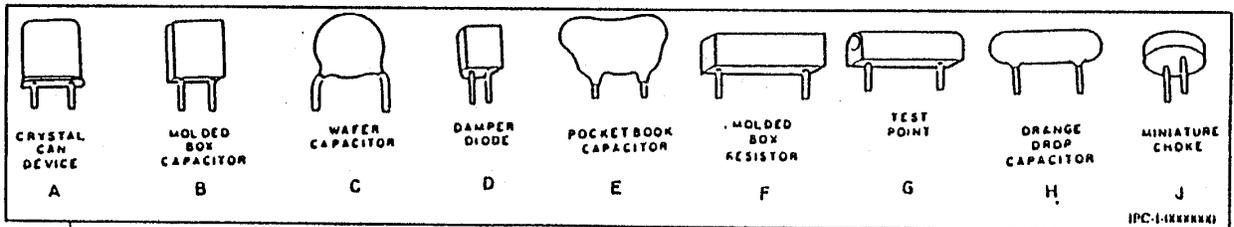
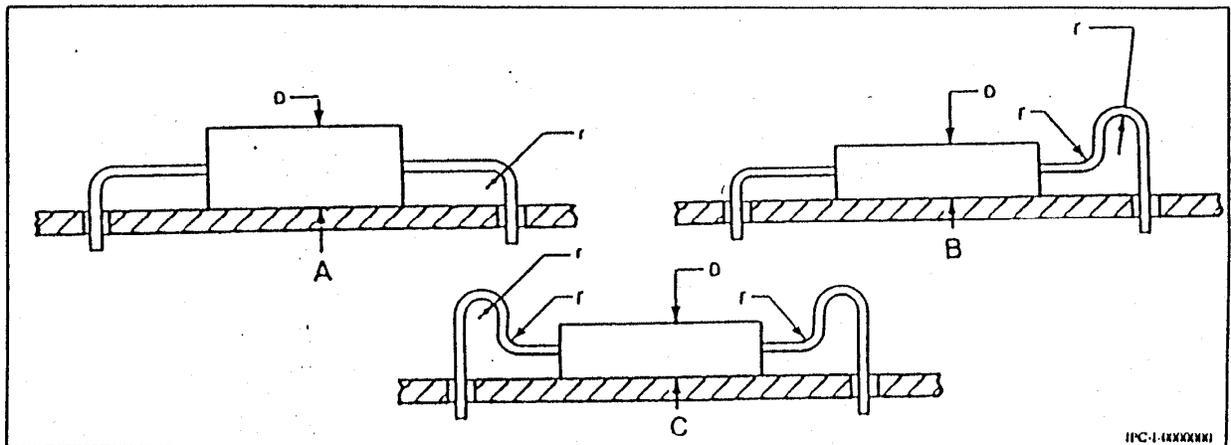


Figure D-2 Typical configuration of components with dual nonaxial-leads



The figures above are excerpted from ANSI/J-STD-001, the Joint Industry Standard for **Requirements for Soldered Electrical and Electronic Assemblies.**