Component Identification
SYLLABUS

In this course, participants will learn how to identify and determine the value of the most common electronic components used in PCB assembly, as well as how to use component markings and assembly documentation to ensure their correct orientation and placement.

The program provides an in-depth look at recognizing component packages, understanding reference designators, deciphering markings, interpreting manufacturer data sheets, analyzing assembly drawings, and utilizing component value tables. Participants will be awarded a certificate of completion upon successful completion of the course.

LEARNING OBJECTIVES PER COURSE MODULE

- Module 1: Introduction
  - Distinguish between through-hole (TH) and surface mount (SMT) components
  - Explain the materials, tools, and processes used to assemble TH, SMT, and mixed technology PCAs
  - Distinguish between component packages and component packaging
- Module 2: Component Verification
  - Describe how markings are used to identify the origin and value of a component
  - Use a manufacturer data sheet to determine the characteristics of a component
  - Use component reference designators to identify the most common types of components
  - Describe the purpose and contents of a bill of materials
  - Recognize the polarity markings of common types of components
  - Recognize the markings used to correctly orient components on a PCB
  - Use component markings, PCA markings, assembly drawings, and sample boards to verify that the right components have been correctly placed and oriented on the assembly.
- Module 3: Resistors
  - Explain the function of a resistor
  - Visually identify the most common types of TH and SMT resistors
  - Explain ohm, tolerance, and PPM (parts per million per degree °C)
  - Interpret component markings and code tables to determine a resistor's value, tolerance, and PPM
  - Use component markings, BOM, packaging, and data sheet to verify that the correct resistor is installed in the correct location on a PCB
  - Examine the characteristics of resistor array and power resistors
  - Determine a resistor's power rating
- Module 4: Capacitors
  - Explain the function of a capacitor

    - Visually identify the most common types of TH and SMT capacitors
    - Explain capacitance and voltage
    - Use a capacitance conversion table (microfarad, nanofarad, picofarad)
    - Interpret component markings to determine capacitance, voltage, and tolerance
    - Use markings, BOMs, packaging, and data sheet to verify that the correct capacitor is installed in the correct location on a PCB
    - Use polarity markings to verify correct orientation on a PCB
- Module 5: Inductors
    - Explain the function of an inductor
    - Explain inductance
    - Visually identify the most common types of TH and SMT inductors
    - Use an inductance conversion table (millihenries, microhenries, nanohenries)
    - Interpret inductor color bands and alphanumeric codes to determine inductance and tolerance
    - Use component markings, BOM, packaging, and data sheet to verify that the correct inductor is installed in the correct location on a PCB
- Module 6: Diodes
    - Explain the function of the most common types of diodes
    - Explain voltage (volts) and current (amperes) and how they determine the operation of diodes
    - Identify the types of component packages used to house the most common types of TH and SMT diodes
    - Use component markings, BOM, packaging, and data sheet to verify that the correct diode is installed in the correct location on a PCB
    - Use polarity markings to verify correct orientation on a PCB
- Module 7: Transistors
    - Explain the characteristics and function of the two most common types of transistors (BJTs and FETs)
    - Identify the types of component packages used to house the most common varieties of TH and SMT diodes
    - Use assembly documentation and manufacturer data sheets to verify the identity value, and characteristics of a transistor
    - Use assembly documentation, data sheets, and component and board markings to identify pin 1 and ensure that transistors are correctly oriented on the PCB
- Module 8: Integrated Circuits
    - Explain the characteristics and function of the most common types of transistors
    - Identify the types of component packages used to house common varieties of TH and SMT diodes
    - Use assembly documentation and manufacturer data sheets to verify the identity value, and characteristics of an integrated circuit
    - Use assembly documentation, data sheets, and component and board markings to identify pin 1 and ensure that integrated circuits are correctly oriented on the PCB

FINAL EXAM

Participants must complete the Final Exam with a passing score of 80% to access and download their Component Identification Certificate of Completion. Students may attempt the exam up to three (3) times. Please note that a third and final attempt is permitted after 24 hours of the second attempt.

COURSE RESOURCES

Everything you need to complete this Component Identification course isincluded and available on the IPC EDGE Learning Management System.

MODULE COMPONENTS AND REQUIREMENTS

The Component Identification course provides engaging videos, activities, and quizzes designed to help you learn, remember, and apply the knowledge and skills you will needto visually identify components during the assembly and inspection of a printed circuit assembly.
The course is arranged into sections comprising the components described in Table 1.

Table 1. Section Components and Description

Module Component	Description
Module Sections	"Bite-sized" segments of text, videos, graphics, and activities that explain the key points of the Module content and provide opportunities for you to think about how you would apply electronics assembly processes at work
Module Post-Quiz	Five to 10-question quiz designed to help you confirm what you know and identify areas that still need work.

STUDY TIPS

1. **Use the Learning Objectives**. Refer to the Module learning objectives often.

   Why? Keeping the learning objectives fresh in your mind supports your ability to stay focused on those aspects of the training that will help you achieve the learning goals for the Module.

2. **Quiz yourself.** After you complete a Module, ask yourself questions such as: ***What are the key ideas? What terms or ideas are new to me? How do these ideas relate to what I already know?*** Then, check the Module content to see how well you did.

Why? Quizzing yourself allows you to identify what you ***really*** know and what you still need to work on.

3. **Quiz yourself periodically.** After you engage with the Module content, quiz yourself and review your answers. Wait a couple of days and quiz yourself again without first reviewing the material.

   Why? Regular self-quizzes help you connect the content to what you already know and what you've thought about since you first learned that content. Tying the content to these other bits of knowledge in your brain makes it easier to recall when you need to apply it on the job later. Research also shows that the effort required to recall what you've learned entrenches it more firmly into your long-term memory than if you were to re-read or highlight the same material.

4. **Mix it up.** When you quiz yourself, mix in topics or questions from different Modules. Online or homemade flashcards can make this fun. Just remember to keep the cards you get right in the rotation even if they appear less often.

   Why? It may be more difficult than practicing one subject at a time, but mixed practice has two distinct advantages. First, because it is more complex and requires more effort, mixed practice more effectively stores the content in your long-term memory. Practicing a lot of the same thing often makes you feel like you've mastered the content, but it's quickly forgotten because you are relying on your short-term memory. Second, in real-life you often have to deal with different types of problems in no particular order. In other words, to be successful, it's better to practice like you play—or work!

5. **Express it in your own words.** Explain the new content to somebody in your own words, or write a summary of each Module, adding images and examples that help you better understand and remember the content.

   Why? Learning, which is ***acquiring knowledge and skills that are easily retrieved from memory so you can address problems and opportunities***, is very much about connecting new stuff to the older stuff already stored in your memory. Therefore, learning the same topic will be a little different for everybody because each one of us is connecting the new knowledge to different old knowledge. In other words, the most durable kind of learning happens when you connect new content with objects, people, and experiences that are meaningful to ***you***. One of the most effective ways to do that is to express newly learned material in your own words.

6. **Dive in.** Read the Module learning objectives, then try to explain the key ideas. How do these ideas relate to what you already know?

   Why? It may seem silly to try to answer a question or solve a problem before being taught how, but you are much more likely to learn and remember the solution if you try to work

your way through it first. In fact, a wide range of experts, from farmers and mechanics to physicists and mathematicians, have sought their answers through a mixture of dogged research and trial and error. Trying to figure something out before you know too much about it puts all your past knowledge to work in search of answers, heightening your awareness of what you do and do not know about the topic at hand. When you hit on those answers, the new knowledge easily and firmly connects to the related concepts and experiences in your memory because you have been actively remembering them.

Even if you are not right on every count, the effort will have primed your brain to find, learn, remember, and recall the Module content that is new to you.

7. **Take time to think about it.** While doing some routine tasks like walking the dog, jogging, or washing the dishes, take a few minutes to think about a recent learning experience. ***What arethe main ideas and how do they relate to my work? Can I apply what I've learned to improve myjob performance?*** If you've already tried to apply what you've learned at work, ask what wentwell and what went poorly. What do you need to learn or do to get better results the next time?

   Why? Thinking about how your past experiences and current know-how relate to what you've recently learned helps to connect and store this new knowledge in your long-term memory so that it is easy to recall when needed. Considering how well you learn something or how well you apply that learning at work will help you identify effective learning and workplace strategies. Think about an especially successful learning or work experience. What was different about those experiences? How can you take what worked and apply it to this situation?

8. **Limit your study time.** Work through relatively small amounts of information in 20- or 30-minute sittings rather than long, continuous study sessions.

   Why? Our brains can only process so much information at a time. Learning is more effective when you give your brain a little time to sort and transfer information from working memory to long-term memory. If you take on too much at a time, or proceed too quickly, you may overload your working memory and forget important parts of the content before they are committed to your long-term memory.

9. **Sleep.** Be sure to get the right amount of sleep. You may be able to function with less, but most healthy adults should get between 7 and 9 hours of sleep each night. Teens and children require more.

   Why? Your brain uses downtime to sort through the day's input, dumping the unnecessary bits and integrating newly learned material with what we already know. While you sleep, the rest of your body goes about repairing tissue, generating new cells, and eliminating toxins. Research shows that healthy sleeping habits lead to improved

mood, weight loss, increased ability to learn and retain information, and better performance.

10. **Cut out distractions.** Set aside your smartphone, and resist answering emails, surfing the Net for your next purchase, or checking in on your Facebook page.

11. **Focus on one thing at a time.** Effective multitasking is a widespread myth. Research shows that multitaskers had a very difficult time sorting through irrelevant material and were outperformed by more singularly focused people across many different measures.

    Why? Aside from compromising the quality of your work, distractions, and multitasking take a big bite out of the limited amount of time you have to get things done. Every time you switch tasks, you waste time getting yourself started on the new task and restarting the one you stopped. Research shows that task switching can eat up to 25% of your time depending on the complexity of the tasks. Twenty-five percent represents 10 hours of a 40-hour work week!

12. **Believe in yourself.** It's important to realize that you can literally increase your brain power and become an expert at whatever you put your mind to. You are not stuck with some finite amount of intellectual ability at birth. In other words, if you think you can or think you can't, you're right.

    Why? Research has proven that the human brain is malleable. It grows new and faster connections through the effort of learning. If you feel that you are "bad" at something like math or gardening, you can become much better with deliberate and persistent study and practice. If you haven't had much success until now, you may have been using poor study strategies. For example, extensive research has shown that multiple re-readings in close succession, highlighting, and continually poring over notes are time-consuming strategies that yield poor results at the cost of the more effective strategies described here. However, you must adjust your mindset to truly take these facts into account. A learning setback is not a result of limited intelligence. It simply means that youmay have to change strategies, increase focus, get creative, or work harder. It's also important to remember that learning things in a permanent and easily retrievable way requires effort.

    The authors of ***Make It Stick: The Science of Successful Learning*** describe how the effort you put into the study strategies described above leads to meaningful learning:

    > Effortful recall of learning…requires that you "reload" or reconstruct the components of the skill or material anew from long-term memory rather than mindlessly repeating them from memory. During this focused, effortful recall, the learning is made pliable again: the most salient aspects of it become clearer, and the consequent reconsolidation helps to reinforce meaning, strengthen

connections to prior knowledge, bolster the cues and retrieval routes for recalling it later, and weaken competing routes.

RESOURCES:

Andreatta, B. (2016). ***Wired to grow: Harness the power of brain science to master any skill.*** Santa Barbara, CA: Seventh Mind Publishing.

Brown, P. C., Roediger, H. L., & McDaniel, M. A. (2014). ***Make it stick: The science of successful learning.*** Cambridge, MA: The Belknap Press of Harvard University Press.

Carey, B. (2015). ***How we learn: The surprising truth about when, where, and why it happens.*** New York, NY: Random House.

Dweck, C. S. (2008). *Mindset: The new psychology of success.* New York, NY: Ballantine Books.

Keller, G. W., & Papasan, J. (2013). ***The one thing: The surprisingly simple truth behind extraordinary results.*** Hudson Bend, TX: Bard Press.

IPC EDGE LEARNING MANAGEMENT SYSTEM

Upon accessing the course for the first time, make sure to take a moment to update your personal profile. IPC EDGE supports the most recent versions of Google Chrome, Firefox, Safari, Internet Explorer, and Microsoft Edge. Courses can be accessed on desktops, laptops, tablets, and mobile phones. Please refer to Browser Settings under the Start Here! Tab on your dashboard to make sure your browser is set to function seamlessly with the IPC Edge Learning Management System. If you need further technical assistance, please send an email to certification@ipc.org or call IPC Member Support at +1 847-597-2862.