
DVD-50C

Introduction to Box Build

Below is a copy of the narration for DVD-50C. The contents for this script were developed by a review group of industry experts and were based on the best available knowledge at the time of development. The narration may be helpful for translation and technical reference.

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Introduction

Box Build Song (to Melody of Bob Marley's "Jammin'")

I'm building – box building wid you
Ooh yeah, we're building.....
and I hope you like building too

Inserting circuit boards, wiring up the power cords, building til the box is done
Torquing every screw until the day is through, we're doing it and having fun

Box building, I want to build it wid you
We be building, and Jah be building too

Opening up the print, searching for a hint, I've done this more than twice
These front panel lamps are causing me some cramps, I sure need some advice

Narrator

This video training program will provide an overview of what's involved in box build. Box build is an *electromechanical* assembly process consisting of *fabricating* the enclosure, or chassis; *installing* subassemblies and components; and *routing* cabling and wire harnesses. The result of box build is the final electronic product – or system – that is shipped to the customer. This product can be a computer, any type of consumer electronics, an avionics system for an aircraft, a life support system in a hospital – or something as compact as a cell phone.

In this introductory section we'll be describing the various elements of box build. These elements include the documentation, the typical subassemblies and components that will be installed into

the chassis, the tools used to perform the box build and the handling and safety issues involved in the process. Section two will present the detailed steps you'll be using to build a typical electronic product.

Let's begin by taking a look at the assembly documentation. The clarity and accuracy of this material is critical for the box build process. There are typically three types of documentation – a Bill of Materials, or BOM; an assembly drawing, or blueprint of the product to be built; and a detailed set of instructions on how to build it.

The Bill of Materials specifies the part numbers and quantities of all the hardware required to build the product. This includes the enclosure, or chassis; all the subassemblies and components; cabling and wire harnesses; and all of the installation hardware.

The assembly drawing or *blueprint* illustrates the physical form of the product – identifying the location of all of the hardware, subassemblies and components. The print may also include partial, exploded, or color-coded views to explain specific details of the drawings.

Finally, the assembly instructions contain the step-by-step sequences required to actually build the box. These instructions are sometimes called *method sheets*. In addition to the detailed build information, the method sheets will specify the tools required for the assembly job and any precautions you'll need to observe.

The completeness and accuracy of the documentation often determines the amount of difficulty and frustration there will be in the box build process. We'll examine these types of situations in section two.

Now, let's discuss some of the typical subassemblies and components we'll be working with during box build. We'll start with the enclosure, or chassis. The chassis is basically the cabinet that all the product's electronic components and hardware are installed in. This enclosure often consists of a top and bottom; side panels; and front and rear panels. Sometimes the front panel contains switches and indicators. Sometimes the back panel contains a series of connectors. It's important to understand that the enclosure can be any size and shape. A cell phone is an example of a very small enclosure.

Next, let's turn our attention to some of the types of subassemblies and components that go into the box. All electronic products have some sort of power supply – that provides power to the electronic components in the system. And almost every electronic product has some type of wire harness. The wire harness interconnects the electronic signals and power to the different parts of the system.

Then we have the printed circuit board assemblies that interconnect the electronic components. These circuit board assemblies control the different functions that make the product work the way it's supposed to. Depending on the types of components used and complexity of the board, these assemblies can be very expensive. They can also be damaged if care is not taken during handling.

One of the biggest causes of circuit board assembly failure is electrostatic discharge, or ESD. ESD occurs when static electricity from your body is discharged into an electronic component. This electricity can degrade or destroy the functionality of certain types of components. There are a wide variety of materials and techniques to eliminate the build up and discharge of static electricity. Refer to IPC-DVD-54C for detailed information on ESD Control.

The general principles, however, are easy to remember. Always be sure that your body, your workplace and the workpiece are at the same electrical potential – by properly grounding the workstation. These grounding wires will capture any built up electrical charges and conduct them harmlessly into the ground. It's also important to make sure that your wrist straps and shoe grounders are operating properly by testing them often.

Other types of subassemblies and components that you'll find in a chassis include fans, card racks, connectors, LEDs and switches.

At this point, let's take a look at some of the tools you'll be working with during the box build process. There are a variety of drivers for the different threaded hardware heads. For example, a Phillips head screwdriver is a common tool for tightening screws. These screwdrivers can be manual or electronic – or even pneumatic. Wrenches are also used to tighten threaded hardware. Torque devices are often attached to the driver to control how much the threaded hardware is tightened. The tool will stop tightening when a pre-specified torque setting, or tightness is reached.

Other common tools used in the box build process include needle-nosed pliers and tweezers; cutters; wire strippers; crimpers; and soldering irons. For a more detailed explanation of these types of tools, refer to IPC's training video on Mechanical Assembly – DVD-46C.

The last topic in this introductory section involves handling and safety issues. Aside from ESD, another critical handling issue involves stacking circuit board assemblies. Stacking the assemblies can cause damage. For example, through-hole component leads can drag across the next board and scratch or damage a conductor. Also, surface mount components soldered directly to the lands are susceptible to being dislodged.

There are also a few safety concerns in box build. The sharp through-hole leads that can damage another circuit board assembly if stacking can also scratch parts of your body and cause injury. That's one of the reasons why it's a good practice to handle the boards by the edges only.

In the same manner, it's important to take care when handling the enclosure panels and other metal hardware that may have sharp edges or burrs. And all of the hand tools you'll be using have the potential to injure you if they are used improperly. If you have any questions about the correct use of tools, don't hesitate to ask your lead or supervisor.

Finally, some components and final products may be large, awkward and difficult to lift. You should make sure you're using proper techniques when you are required to lift a heavy object. And don't feel embarrassed about asking one of your co-workers to help you lift a heavy object.

Now that you've been introduced to the basic elements of box build, let's examine the step-by-step details of the process. For the purpose of this program, we'll be examining the building of a typical product. Although the boxes you'll be building may be more or less complicated, the general principles will always apply. The box build process begins when the materials for a particular product are delivered to the box build area from the stockroom.

It's important to verify the part numbers and quantities of the materials on the cart against the bill of materials. Some companies have their technicians use a highlighter to check off each subassembly, component and hardware they verify. After the materials are confirmed, they are brought to the box build workstation.

Let's take a closer look at some of the materials we'll be using for this project. These include the chassis; subassemblies; and the hardware required for the build. In order to perform box build correctly, you'll need to become familiar with and follow the exact sequences and methods specified in the assembly drawings and instructions.

We can now begin the job. The box we'll be building is called a *Digital Expansion Interface*. As you can see, the first task is to prepare the power entry module. Remove the fuse holder cover and install the fuse. Then, connect the power, common and ground wires to the corresponding spade terminals on the power entry module. Notice that the power wire is black; the common, or neutral wire is white; and the ground wire is green.

Next, the plastic circuit board rails are inserted into the tracks on either side of the chassis board guides. These rails should be installed with the slots facing in – so that a tester board can slide properly into the rails.

Now, the wires that are connected to the power entry module are fed through the opening in the chassis – and the power entry module is snapped in place. Then the lug on the green ground wire is placed over the threaded standoff and is secured with this combination hex nut / lock washer – using a hex nut driver.

The next step is to install the fan. Align the fan so that it slides over the single standoff. Then secure it with this Phillips head screw using a manual screwdriver. At this point, we'll affix labels to the chassis. We'll start with the customer label that goes on the bottom of the chassis. Then the panel labels are set in their proper position. Finally, the barcode label is adhered to the chassis. Next, the terminal ring is attached to the panel with a combination hex nut / lock washer using a hex nut driver. Then we use a hex driver to install the threaded hardware for the two panel connectors.

Now, we'll install the power supply. An electronic screwdriver with a torque device is used to secure the power supply to the bottom of the chassis. Note that the assembly instructions specify a torque setting of 4 inch pounds. It's important to verify that the torque device has been calibrated. After the power supply has been installed, we connect the wires from the power entry module. Then we plug in this cable assembly connector that will eventually connect the power supply to the motherboard.

Next, we secure the LED circuit board to the chassis using two Phillips head screws. Then plug in the LED board connector. At this point, the motherboard can be installed. Carefully align and orient the circuit board so that it sits in its proper location. Using the torque driver, screw the motherboard to the chassis with Phillips head screws. The final screw does double duty by providing an anchor for the plastic wire harness clamp. Then, the cables from the fan, the LED board and the power supply are carefully plugged into the specified connector receptacles on the motherboard. At this point, the cables from the fan and power entry module are neatly tied together – and the excess tie material is cut off.

The *bezel*, or nameplate, is now attached to the chassis cover. Notice how these tabs are bent to lock the bezel in place. Next, we slide on the chassis cover. The torque driver is used to secure the screws that attach the cover to the chassis. Now, the fuse label is affixed. The final step in this particular box build process is to attach the covers for the test board openings. The fully assembled product is now ready for functional testing before being shipped to the customer.

The important thing to remember is that every box build situation will have its own individual requirements and challenges. The key is to become completely familiar with the assembly documentation and to consult with team members to find the most effective ways to handle any box build problems.

This program has provided a detailed overview of a typical box build operation. We discussed the documentation you'll be using; the subassemblies, components and hardware you'll likely encounter; the tools required for the job; and the handling and safety issues involved in the process. Then we explained the step-by-step process used to build an electronic product. When you take pride in performing your job well, the final electronic product should function safely and reliably for many years.