

Department of Electrical Engineering, The University of Texas At Dallas
EE 2110: Beginning Digital Logic and Computer Fundamentals Laboratory
Experiment #5 – Assembling a Pentium IV® Personal Computer

- 1. Introduction:** In this exercise, we will assemble an IBM-Compatible Personal Computer. This PC is a standard model, using an Intel Pentium IV® processor. The assembly exercise will include physical installation of the computer central processor unit (CPU) board, or “motherboard,” in the mid-tower chassis, inserting interface cards, cabling the motherboard to the various peripherals, and loading required software. The primary software to be loaded will be the Microsoft Windows XP® operating system, which will be demonstrated after loading.
- 2. Goal of this exercise:** The purpose of this lab is to familiarize students with the various components and subsystems that make up a standard PC. It will also familiarize participants with the installation of Windows XP® on the PC and with various other software programs that must be loaded for the computer to run correctly.
- 3. Theory of experiment:** There is no theory section associated with this exercise. The experiment simply gives teams both assembly and Windows® OS experience with a PC.
- 4. Experimental Equipment List:** The following components are required for this experimental procedure:
 - Mid-tower ATX chassis with power supply
 - GA-81PE1000-G Gigabyte (or similar) CPU ATX motherboard with cable assemblies, manual, required software drivers, and on-board sound processor
 - 256- or 512-Mbyte DRAM dual in-line memory module (DIMM), depending on kit
 - Floppy disk drive (FDD)
 - Hard disk drive (HDD), various manufacturers, 20-80 GByte, depending on kit
 - CD ROM or DVD disk drive
 - Standard 104-key PC keyboard
 - IBM PS/2 mouse and mouse pad or equivalent
 - Video card (various manufacturers and memory amounts)
 - 17-inch color LCD monitor (on bench-top)
 - Multimedia Speaker System (various manufacturers)
 - Tool kit with screwdrivers, pliers, other common tools
 - Windows XP® software, plus motherboard and video card software CD-ROMs
- 5. Pre-Work: Note:** Please study the following write-up carefully in advance, to become familiar with the PC assembly process.

6. Experimental Procedure – Assembling the PC:

- 1) Inventory your assigned parts complement, and make sure that you have all the parts listed. Notify your TA if you are missing a part or subsystem. / _____ Done.
- 2) Removal of mid-tower cover: / _____ Done.
 - Set the mid-tower on its right side (as seen from the front) on your assigned workbench.
 - You will be removing the left-side chassis cover.
 - Remove the 2 thumb or Phillips screws that hold the chassis cover in place (they are at the rear of the chassis). You will probably not need a screw driver for the thumb screws, but you will need a Phillips screwdriver for the other type. The thumb screws also have Phillips provisions on their top if they are particularly tight.
 - Push chassis cover rearward about 1 inch, then lift upward. The chassis cover may be “stiff,” and you may need to jar it slightly to get it loose. Set it aside (be careful to save chassis screws in the motherboard box).
- 3) Chassis check – please check the chassis assembly for the following items: / _____ Done.
 - There should be six brass stand-off screw fittings in place on the chassis “bottom” (actually the chassis right-side cover). Note: there may be seven stand-offs in some chasses.
- 4) Unpacking and preparation of the motherboard: / _____ Done.
 - **MAKE SURE THAT EACH PERSON TOUCHING THE MOTHERBOARD WEARS THE ANTI-STATIC WRIST STRAP, AND THAT IT IS CONNECTED TO THE GROUNDING RECEPTACLE UNDER THE BENCH BY ITS GROUNDING CABLE.**
 - Open the motherboard container and remove the board in its anti-static plastic sack.
 - Check that the Intel Pentium ® CPU is installed and the cooling fan is properly attached.
- 5) Installation of the DIMM (dual in-line memory module): / _____ Done.
 - **Once again, the person doing the DIMM installation should be wearing the ground strap, which must be connected to the grounding receptacle.**
 - Remove the 256 or 512 MByte DIMM from the anti-static package. Occasionally, a DIMM will be left in the motherboard. If so in your case, please have one partner remove it and the other reinstall it, to get the experience of handling the memory module. The DIMM is easily removed by pressing the ejector tabs on each end of the DIMM socket.
 - (NOTE: In this exercise, there are numerous references to the motherboard manual. Although all motherboards in the kits provided for this experiment are the same basic design, there are minor variations, and the manuals are slightly different over the various motherboard variations. For that reason, pages references are not given to the manuals. However, these manuals are quite small, and a brief reading at this point will probably let you spot the various sections that will be of use to you during the experimental exercise. In addition to the manuals, there is a yellow quick assembly card for one version of the board, and a quick assembly brochure for another model. These are either in the motherboard box or pasted to the chassis side that you disconnected, in some of the motherboard kits. These can be very useful alternatives to the motherboard manual.)
 - Align the module with the DIMM 1 connector. This is the DIMM slot closest to the CPU; refer to the motherboard manual for this connector position – the connector is also marked on the motherboard. Push the ejector tabs out on the DIMM slot. Make certain that the ridge key in the connector lines up with the slot in the DIMM. Making sure that the DIMM ends do not interfere with the ejector tabs, firmly press the memory module into the connector. The fit of the module into the connector is supposed to be tight, so some “gentle” force may be required to seat the module. As you insert the DIMM into the slot, the ejector tabs will pop up into vertical position.
- 6) Installation of the motherboard on the drawer bottom: / _____ Done.
 - Check to see if there are several (three or more) nylon stand-off supports installed in the motherboard. If not, install them (they should be in the screw kit in your box if not already installed). These supports help to keep the motherboard rigid when installed.
 - Make sure that you install the rear panel socket cover on the back panel of the chassis, if it is not already in place. The connectors on the motherboard will protrude through the various openings in this panel when the motherboard is correctly installed in the chassis.

- Carefully align the screw holes in the motherboard with the brass standoffs on the chassis.
 - Put the motherboard into place and fasten with Philips-head screws. You may have to adjust (i.e., “wobble”) the connectors on the side of the motherboard toward the rear of the chassis to fit firmly through the openings of the socket cover that you just installed.
 - Tighten the screws firmly but **DO NOT OVERTIGHTEN**.
- 7) Note: There are no motherboard parameters (switches or jumpers) to be configured.
- 8) Installation of Video Card on motherboard: / _____ Done.
- Take the video card from its plastic sleeve and position it over the green AGP connector (check motherboard manual).
 - Make sure that the metal connector slot cover is to the rear, and that the cover is over the edge of the motherboard.
 - In one version of the chassis, you must :
 - Remove the plastic snap connector that holds the accessory cards in place.
 - Press the video card firmly in place, making sure that the metal flange at the top of the slot cover matches the hole on the back panel (you will not need to use this screw hole), and that the latching pin at the bottom of the board (at end of the connector) snaps into the locked position.
 - Fasten the cover in place by reattaching the plastic snap connector.
 - In other versions of this chassis, you must:
 - Simply press the video card firmly in place, making sure that the metal flange at the top of the slot cover matches the hole on the back panel, and that the latching pin at the bottom of the board (at end of the connector) snaps into the locked position.
 - Fasten the video card in place using one of the small screws in your kit similar to the screws that hold the side panel in place.
- 9) Floppy disk drive (FDD)/hard disk drive (HDD) installation verification: / _____ Done.
- The HDD and FDD must be installed before we can activate the computer.
 - Check that the FDD is in place in the upper of front panel slot (the slot is marked “FDD” on the interior chassis panel). It should be secured in its slot by four small screws on the outside of each of the two metal side panels holding it in place.
 - Check that the HDD is installed in the second slot beneath the FDD (not accessible from the front panel). It is also held in place by four screws. Note that the HDD slot is also marked on the interior chassis panel.
- 10) Connection of power cables: / _____ Done.
- The power supply has a number of power cables which will be found lying in the chassis. One end of all the cables goes into the power supply.
 - Two of the cables are 4-conductor power cables, each with two large four-pin power plugs on it. Note that the plugs on these cables can only plug in one way. The cables also have a third, smaller plug attached.
 - Choosing one of the cables with the small plug, attach either of the large plugs to the HDD power receptacle. The other large plug will be unused.
 - The FDD takes the smaller power plug on this power cable. Insert this small plug into the FDD power receptacle.
- 11) Power supply connection to motherboard: / _____ Done.
- Locate the large (multiwire) power cable, with the very large (two-tier) plug.
 - Insert this plug into the translucent nylon connector socket on the disk-drive side of the motherboard. The connector is keyed and can only be inserted one way.
 - Now find a four-pin plug on a cable with four wires, two of which are yellow and two of which are black. This power plug is inserted into the motherboard receptacle that is just beneath the chassis fan (check manual, yellow card, or brochure, if included).
- 12) CD or DVD ROM drive check: / _____ Done.
- Check that the CD/DVD drive is properly connected in the upper chassis slot. It is held in place by a plastic slide connector or four screws (depending on chassis model). If it uses a slide, check to see that this slide connector is in the “up” (locked) position.
 - Connect one of the large plugs on the second power cable to the CD-ROM drive.
 - There may be a medium-sized plug on another power cable; this cable and plug are not used.

- 13) Chassis fan connection: / _____ Done.
- Connect the 3-wire cable from the chassis fan to the 3-pin connector on the motherboard.
 - Note: the 3-pin connector on the motherboard is labeled “sys_fan.” See the motherboard outline diagram in the motherboard manual. Note: this fan may already be connected to the power supply in one version of the chassis.
- 14) Attaching signal cables to the disk drives: / _____ Done.
- There are a number of flat cables that carry signals from the motherboard to the disk drives.
 - Attach the 34-conductor flat cable (narrower flat cable) to the motherboard FDD signal receptacle (reference the motherboard diagram in the manual) and to the FDD receptacle. Note that the #1 pin is on the side of the cable with the “red tracer” edge (it is blue on some cables). This connector is also keyed.
 - Connect an IDE cable (40-wire; larger flat cable) to the HDD receptacle, using the gray connector plug on the cable, and to the motherboard “primary” HDD receptacle (motherboard manual), plugging into the red receptacle.
 - Connect the second 40-wire flat cable to the receptacle on the CD ROM and to the white receptacle on the motherboard. The CD ROM signal cable is keyed, and attaches with the same orientation as the HDD cable. Note: in some chasses, there is only one 40-wire flat cable, and it has a third plug on the far end that can be connected to the CD-ROM/DVD.
- 15) Connections to front panel of mid-tower chassis: / _____ Done.
- Connect the front panel chassis speaker, reset switch, power LED, HDD LED (some models may not have an HDD light), and front-panel ON switch cables to the mother board F-Panel plug, as shown in the motherboard manual.
 - Note that the F Panel plug is on the corner of the motherboard on the same end as the PCI-bus receptacles, but on the opposite side (ref. motherboard diagram).
 - Make sure that proper polarities are observed, as indicated in the diagrams.
 - Note that connecting all these very small cables to the single “F Panel” connector can be extremely tedious. Also, the marking on the actual receptacle and on the drawings is tiny, and the orientation of some of the cable connections is odd and can be confusing. Simply take your time and make sure that you positively identify each connector position before plugging that connector into place on the F Panel.
 - Note: If there is a set of front-panel USB or audio ports, do not connect these, as they will not be needed in this exercise. You can use the rear USB ports as needed.
- 16) Readyng computer for startup: / _____ Done.
- Note: At this time, we will not install the left chassis cover, since some internal chassis adjustments may still be required.
 - Stand the chassis up on its feet, rear panel facing forward.
 - Place the keyboard and mouse on the bench on either side of the PC chassis, with the mouse to the right of the keyboard, on the supplied mouse pad. The monitor should remain on the upper ledge of the bench.
 - Plug the monitor into the receptacle of the video board installed earlier. Make sure that the thumbscrews are firmly tightened.
 - Plug in the keyboard to the round purple connector on the rear panel. Note: this connector is “keyed,” that is, it has a ridge internally so that it will only connect in one position. You may have to rotate it slowly to get it to insert.
 - Plug the mouse into the round green P/S-2 connector on the rear panel (also keyed). Make sure that the colors are correct, as the mouse and keyboard connectors are interchangeable.
 - Plug the power cable into the rear receptacle on the chassis.
 - Turn the chassis around so that front panel faces forward.
- 17) Power-up sequence: / _____ Done.
- Plug the LCD monitor into one of the 120 V. outlets on your bench power panel and turn on the power switch (lower right front side of monitor). The monitor “On” light should come on. It should be colored amber at first.
 - Make sure the PC chassis power switch is “Off” (rear of chassis). Plug in the chassis power plug.

- Turn on chassis power switch on rear panel, then press the front “On” button. The front panel “power” light should come on permanently, and the HDD light (if included) should come on briefly, the CPU fan should come on, and the power supply fan should also start up.
- At this point a display should appear on the screen of the monitor (the display “On” light should also turn green). Press the “Del” key several times until a pop-up window titled “CMOS Setup Utility” appears on the monitor.

18) Loading setup defaults. / _____ Done.

- There are a number of setup options to choose. These are basic operating parameters of the “BIOS,” (also called the CMOS), the micro-operating system that starts PC operation.
- The “standard CMOS features” option should be highlighted at the upper left (mouse will not work at this point – use keyboard up/down arrows). Then press the “Enter” key.
- A standard setup window will appear.
- Verify the date and time. If they are not correct, each item is set by highlighting it using the arrow keys and then using the page up and page down keys to change the value until the right hour, minute, day, etc., is achieved. Using this method, set the year, month, date, and time. Note that the time is set in 24-hour clock form.
- Check that Drive A is “1.44 M, 3.5 in.” This means that the CPU has checked and found that the FDD is installed.
- Note that by this time, CMOS has detected the disk drives – the HDD is set as the “primary master,” or “IDE Channel 0 Master” and the “secondary master,” the “IDE Channel 1 Master” is the CD or DVD.
- Press “Esc” key. The original CMOS Setup window returns.
- Tab to “Advanced BIOS Features” and hit “Enter.” This window should display the order in which the BIOS looks to each disk unit as the boot master. The first should be the FDD, the second should be the CD/DVD, and the third the HDD. If this is correct, hit “Escape” and return to the top CMOS setup screen.
- Tab down to “Load optimized defaults (Y/N)?” Press “Y” and “Enter.”
- Open the CD/DVD drive and insert the Windows XP disk supplied.
- Tab down to “Save and exit setup? (Y/N)?” Press “Y” and “Enter.” Note: your BIOS may have you press F10 to get to the “Save to CMOS and EXIT (Y/N)?” choice. Do so if required and then press “Y” and Return.

19) System start-up from CD/DVD: / _____ Done.

- When you press “Y” and Return above, the computer will exit BIOS and start to reboot. Since there is nothing in the FDD, the CPU will discover the Windows CD in that drive and ask to “Press any key to boot from CD.” Press a key and wait for the boot-up screen. You should get a blue screen that says “Windows Setup.” This means that the computer is ready to install Windows XP ® at this time. At the bottom of the display, it will inform you that Windows is loading a great many setup files. This may take a minute or two.
- A screen will come up that says “Welcome to Setup.” It will give you three options to continue. You should press “Enter” to began Windows XP ® setup.
- You will get a chance to read the Licensing agreement. Press “F8” for “I agree.”
- You will probably have a computer HDD that already has Windows XP ® installed on it. If so, Setup will give you the opportunity to repair the current Windows installation. You are starting over, so decline this by pressing the Escape key (ESC).

20) Partitioning of HDD: / _____ Done.

- You must now partition and format the HDD so that it is usable for both booting the system and for storing data.
- A screen may pop up informing you that there is an existing partition. Whether or not there is one, you want to start over, so delete the current partition if it exists, and then create a new partition. If there is no partition, you will get to create one (see below). Note: the system makes VERY SURE that you really, REALLY want to delete the partition! Simply follow the directions to do so.
- The display will then show the disk as unpartitioned space. You then press “C” to partition the space. Press “Enter” to complete the partition.

- You should get a screen that says you have one large partition (depending on disk size) plus 8 Mbytes of unpartitioned space (the operating system reserves 8 Mbytes, which is okay). You must then press “Enter” again to finally install the partition.
- 21) Formatting of HDD: /_____ Done.
- You now get a chance to format the disk. The screen gives you two options – format quick and regular format, which takes about 15-20 minutes. In this case, the quick format is okay, but you may do the longer formatting if you wish – it not only cleans the directories but also the entire disk to some extent.
 - You will get notification on the screen: “Setup is formatting.” The system shows the progress on formatting in terms of %. This will take some time, as noted above – less so for the quick format.
 - Once your disk is formatted, Windows Setup will automatically begin to copy files to the hard drive to begin the installation of Windows XP ®.
 - The HDD is now formatted.
- 22) Loading the Windows® operating system: /_____ Done.
- When the files are all copied off the Windows CD, installation is ready to begin.
 - The display will tell you that you should reboot, but will do so automatically after several seconds.
 - At this point, Windows XP ® installation will begin. Simply watch the display and interact as necessary – you are required to answer a few questions. This installation will take on the order of 30 minutes, depending on the disk drive and the speed of your CPU.
 - You will be offered language options. Ignore, click “Next” and the program will continue.
 - Enter a name as asked for (e.g., “Our PC Team”) – for organization, enter “UTD.”
 - You will then have to enter the product key, the password that allows installation. This key is on your CD-ROM jewel case. Enter the five sets of characters in the five boxes shown.
 - You will get a screen with a suggested computer name. Use it, and DO NOT enter a password. Leave the administrator password BLANK.
 - Confirm the date and time settings on the display, and the time zone. Setup will continue for about 30 minutes, as noted above.
 - At the end, Windows XP ® will automatically restart your computer.
 - Windows ® will automatically adjust your screen resolution for the display you are using (you must click on an “Okay” if you can read the pop-up window all right).
 - Windows ® will tell you that you are going to set up some parameters. Click “Next.”
 - You will get a window asking who will use the computer. Simply enter any name and click “Next” again.
 - Now click “Finish.” You will see a “Welcome” sign, and then the Windows XP ® Desktop. Your Windows XP ® operating system is installed.
- 23) Closing up computer and adding speakers and audio software: /_____ Done.
- Clicking the “Start” button on the lower left of the screen, select “Shut Down” and properly shut down Windows®. Turn off the power on the rear of the chassis (leave chassis plugged in – this keeps the chassis well grounded).
 - Lay the chassis on its side with the side “hole” up and the motherboard at the bottom.
 - Replace left-side chassis cover and fasten with two screws at rear of chassis.
 - Stand up the mid-tower chassis, with the rear panel facing out.
 - Set up the speakers near the PC. Plug the right speaker cable into the outlet on the left speaker (on some speaker sets, this is not necessary as the speakers are already connected). One of the speakers has an audio speaker input cable attached. Plug this speaker cable into the audio-out receptacle on the motherboard (colored light green). That same speaker box should also contain the audio amplifier; plug its power cable into the 120 V. bench outlet.
 - Turn the mid-tower around so that the front panel is forward. Turn on the chassis power and speaker power (switch on one speaker).
 - Since the audio capability is built into this model of motherboard, Windows® “Plug and Play” software already should discover the audio circuits. However, this motherboard (and the audio circuit) may or may not be comprehended in the Windows XP ® audio driver

library (and probably will not be), so that no software driver may be discovered. In that case, you will probably be asked to load the audio software.

- When this occurs, insert the “Motherboard CD Utility” that came with your Gigabyte motherboard and follow instructions to install the audio drivers.
- If no request to install audio software occurs, when Windows® completes startup, double-click on “My Computer” on the desktop (i.e., the icon on the screen), then click on “System” and then on “Hardware.” Under hardware, click on “Device Manager.” You should see a listing for “unknown media device,” or a media item with a title like “Multimedia Audio Controller” with a question mark beside it. At this point, insert the motherboard CD and follow instructions to install the audio software.
- Re-start the PC as before, and the audio should be active (you should get a sound “flourish” as Windows® comes up).

24) Video software: / _____ Done.

- You may need to install the video driver software. Check the “Display” status under “Control Panel” on your Windows XP ® Start menu. Click “Shortcut to Display.” When the display menu come up, click on the “Settings” tab at the top. Your color quality should say “Highest (32 bit).” If not:
 - Locate the Display Driver CD-ROM in your motherboard box.
 - Load the CD into the CD ROM drive and follow instructions to install the proper video driver software.

25) Your PC assembly and Windows XP ® installation is complete.

7. Experimental Procedure – Demonstration of Achievement (Second Session):

You will now have the opportunity to demonstrate your handiwork in assembling the PC system. You and your partner will demonstrate the following items to the instructor:

1. **Windows® startup** – Turn the system on and show that Windows® boots correctly. This shows that you have successfully assembled the computer and installed the major software systems correctly.
2. **Demonstrate the sound function.** There are some Windows Media Player music samples available. Locate them and demonstrate by playing one of them to show that the audio system is working correctly. You may also bring a music CD to demo sound card operation.
3. **Wallpaper** – Demonstrate that you can locate the display setup and set the background for the screen (called “wallpaper”).
4. **Screen saver** – Locate the display setup and choose a screen saver. Demonstrate that it works properly.
5. **Video game** – Bring a video game to your second PC assembly session. Load the video game and start it up – this shows that the audio and video software drivers work and that programs can be loaded from the CD ROM/DVD. If it is a modern video game, it is typically one of the most “stressful” items you can load – it will use computer resources to the maximum.

8. **Equipment Shut-down:** The experimental procedure is complete. Please exit all programs and go through the Windows® shut-down procedure. After shutting down Windows®, turn off the PC and monitor, and switch off the bench power. Disassemble your PC, put the parts into the motherboard box, and store the parts and the chassis in the cabinet as directed by your TA. Note: Some teams may be asked to keep their PC’s assembled to be used as a programming platform in future classes. Simply follow your TA’s instructions, keeping the PC assembled or disassembling as directed. Return the tool kit and grounding straps to the TA so that they will be available for the next class. Make sure that the work area where you assembled the PC is clean. Also be sure that all software diskettes plus any other parts that

originated in the motherboard box (DIMM in its conducting plastic sack, manual, cables, etc.) are collected and put back into it before storing.

- **NOTE: Do NOT put any tools or the grounding straps in the motherboard box! They are needed by the other teams to do the assembly exercise.**

9. Laboratory Report: As usual, please follow the laboratory report form. In your write-up, discuss your experiences with the assembly of the PC plus any important things that you learned in the exercise. Also include the following items:

- 1) Was the procedure easy to follow? How could it be improved? How?
- 2) Assess your team's performance. What did you do well? What would you do differently next time?
- 3) What was the hardest item for your team to perform in this assembly?
- 4) What surprised you about the assembly of a PC?
- 5) Did your previous work (studying digital logic, etc.) make the "concepts" of the PC easier?
- 6) Does this lab help you in understanding the basic structure of the PC? If yes, how? If not, why not?