Terminating 25-Pair Cable and 4-Pair Cross Connects

Estimated Time: 90 minutes  
Number of Teams: 2  
Number of Team Members: one to four

This Lab has four major parts that will be addressed separately.

1. Terminating 25-Pair Cable  
2. Terminating Category 5e to a 110 Block  
3. Terminating a Category 5e Cable on a Category 5e Patch Panel  
4. Testing the cables from end-to-end  
5. Create Labels

Part 1: Terminating 25-Pair Cable

Estimated Time: 30 minutes  
Number of Team Members: one to four  
Number of Teams: Minimum of two

Objectives:
- Fan out a 25-pair UTP cable onto a 110 frame using the standard color code.  
- Place wires in termination points.  
- Punch the wires down with the multi-pair punch tool or single-pair punch tool.  
- Terminate wires using C5 clips with the multi-pair punch tool.  
- Test the cable using the Fluke Networks 620 LAN Cable Meter and two RJ-45 to 110 adapter cables.

Overview:
Cable color-coding is a skill that needs to be mastered in order to perform accurate work in a timely manner. Neatness is essential when handling multi-pair cables. This lab will reinforce the 25-pair color code and build proficiency in punching down and terminating 25-pair cables. C clips are used to complete the connection of the punch down. C clips come in 3-pair, 4-pair and 5-pair versions. 5-pair, or C5 clips, are generally used for terminating 25-pair cable. 4-pair clips are usually used for four-pair cables. 3-pair clips are generally used for Category 3 (voice) cable. The multi-pair punch tool can be used to simultaneously punch and cut five pairs at one time. Either the single-pair punch tool or the multi-pair punch tool can be used for punching down the wires on a 110 block. The C5 clip must be installed using the multi-pair punch tool.
Note: There are 25 positions for pairs of wires on each row of a 110 block. All are used when punching down a 25-pair cable. Only 24 are used when punching down 4-pair cables. During this lab, 25-pair UTP cable will be positioned onto a 110 connection block. The 25-pair cable that was spliced in a previous lab will be punched down. Testing the cable after punch down will verify the accuracy of the punch down and the integrity of the splice. The pairs will be punched down and terminated. The C clips will also be removed in this lab.

Examples of C3, C4, and C5 Clips

5-Pair Multi-Punch Tool

The 5-pair multi-punch tool is a high impact tool that is not suitable for use on patch panels that use a printed circuit board. The tool can be used to seat and cut cables and terminate wires with C clips. The cutting blades are reversible and replaceable. To remove or reverse cutting blades, twist the head of the tool until the detent position is released. Remove the head from the handle. The components of the head can now be slid apart. Notice: If the blades are installed facing forward, the tool will cut. If the blades are installed facing the rear, the tool will punch but not cut. The tool is used at a 90-degree angle to the block when seating C clips. When punching and cutting, it is sometimes helpful to hold the tool at a slight angle towards the blades to insure that the wires are cut.

The Single wire punch tool has reversible and interchangeable blades. Twisting the blade 1/4 turn can remove the blades. One end of the blade will cut and punch, the other end will only punch. The blade is re-inserted into the tool and twisted to lock it
into place. The tool has an adjustable impact setting. The high impact setting is used when punching wires. Spare blades can be stored in the handle of the tool.

**Preparation:**
The two teams will decide which Simulated TR will be the start location (e.g., the MDF) and which will be the destination TR for the pull. The teams will then jointly pull the cable from the Simulated MDF to the TR. One team will work with one end of the cable while another team will work with the other end.

**Tools and Resources:**
- 110 frame
- Category 5 25-pair UTP cable
- C5 clips
- Multi-punch tool
- Single punch tool
- Diagonal cutters
- Permanent marking pen
- Tape measure
- Scissors
- 2 RJ-45 to 110 adapter cables
- Fluke Networks 620 LAN Cable Meter

**Safety**
Safety glasses should always be worn when using cutting tools.

**Step 1 Route the cable from behind the block**
The instructor or lab assistant will provide a 25-pair cable with a splice in the center. Route the cable from behind the block, out to the right, and onto a vacant row of the 110 block. When routing multiple cables to the same block, alternate routing each cable from the left or right to avoid overcrowding one side of the block.

**Step 2 Remove the sheath**
Be careful to remove the sheath without damaging the conductors. Using the measuring tape, measure at least 35 cm (14 in.) from the end of the cable and put a mark on the cable. Using the scissors, carefully cut the outer sheathing of the cable 2.5 cm (1 in.) from the end without cutting the conductors. Use the ripcord to open the sheath. Cut off the ripcord and the sheath as close as possible to the marked length. Tie the end of the bundle with a scrap piece of wire to keep the pairs from separating. After the sheath is removed, handle the cable gently to prevent the untwisting of the pairs. How are the twists in this cable different from 4-pair cables? Remember not to cut into the insulation or copper cores of the wires. This is a very costly mistake that is to be avoided on the job.

**Step 3 Fan the wire pairs to their termination points.**
Beginning with the white/blue pair, place the colored pairs according to standard color code on the termination points. At the first termination point, try not to have more than 2.5 cm (1 in.) of the conductors exposed. Moving along the block, it will
be necessary to have more of the conductors exposed. Make sure all cables are parallel to each other and with no tension at the point of connection. Pair untwists must be less than 7.5 cm (3 in.) for Category 3 cable. Make sure to maintain the minimum bend radius allowed for this type of cable, which is 2.5 cm (1 in.). Place five pairs of the wires in their termination points on the block, one pair at a time, pressing firmly to insure the pair will stay in place. Inspect the placement of the wires to make sure they are in the correct termination points. Remember that the tip colors go to the left and the ring colors go to the right.

What are all of the tip colors? _____________________________________________
What are all of the ring colors? _____________________________________________

Step 4 Punch Down
Use either the single punch tool or the multi-punch tool to punch and cut the conductors. Use the same method as in step 3 to insert the next five pairs of wires
(the red group) into their terminations points and punch them down. Punch down the rest of the color groups in the same manner.

**Step 5 Inspection**
Carefully inspect the placement of the wires for accuracy and neatness. At this point, the wires can still be removed and correctly punched down if there has been a mistake made using a minimum of extra time. Once the pairs have been terminated with C5 clips, fixing a color code mistake will take too much extra time.

**Step 6 Terminate**
Place the C5 clips over the inserted wires. Clips can be installed upside down in error. Make sure to seat the C5 clips with the imprinted color code in the proper order. The color blue should be to the left. Place the head of the multi punch tool over the clip. Push on the tool until the impact seats the C5 clip. Terminate all 25 wires on the block using C5 clips.

**Step 7 Testing the terminations**
The RJ-45-to-110 adapter cable allows the testing of four wire pairs at one time. Plug the 110 end over the first four pairs of wires on the block. Plug another RJ-45-to-110 adapter onto the first four pairs of the 110 block at the other end of the cable. Test, using the Fluke 620. Make sure the meter is set to Category 3 cable and the EIA /TIA 4PR standard. The results of the test should be the same as a straight-through cable. Unplug the 110-to-RJ-45 adapters and plug them in over the next four pairs. Pay careful attention to the sequence and the color code. Continue this process, testing four pairs at a time with the Fluke 620. After testing the first six sets of wire pairs, pair 25 is left over. Plug the 110-to-RJ-45 adapters into pairs 22 through 25 to test the last pair. If problems are found in the wires, note them as they are tested. Test the entire cable before looking for the trouble spots. If problems are found, examine both ends of the punch down and then examine the splice.

Fill in the chart below with the results.

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<th>Pairs</th>
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Note: In order to test pair 25, install the adapters on pairs 22-25 and record only the data for the last pair (25).
Part 2: Terminating Category 5e to a 110 Block

Estimated Time: 30 minutes
Number of Team Members: one to four

Objectives:

- Terminate Category 5e cable to a 110-type termination block as a crossconnect.
- Properly use a 110 punch-down tool and 110 multipunch tool.

Overview:

In order to prepare cross-connect blocks, the installer must be able to properly punch-down a 110 block. It is important that each punch-down is executed correctly to ensure proper connectivity. A 110 punch-down block is a device used to terminate wires in a common place. Wires from internal data networks and telephones serviced by a telecommunications room are collected in the block.

Wires from outside the telecommunications room are collected in a separate block. These two blocks provide a way to connect the two collections of wires in order to supply connectivity from external sources to the desktop. This system of wire management keeps the wires organized and allows for quick changes.

A C connector is used for four-pair cables. The C connector is used to make the actual connection to the cable. Place the C connector over the wires punched down, being sure to match the color-coding correctly. Position the 110 multipunch tool over the C connector. The multipunch tool is used to seat the C connector. Press firmly on the multipunch tool until it clicks. This will ensure that the C connector has been attached correctly and the wire has been properly terminated.

The cross connections from a 110 block are made on the top of the C connector and those wires/cables are routed out of the block through the middle/top/bottom of the block in such a manner as not to cover the labels.

Required Resources:

- 110 punch block
- 1 m (3 feet) of Category 5e UTP cable
- Label dispenser and permanent marking pen
- 110 C-4 connectors
- Copper strip tool
- Impact tool with 110 cutting blade
- 110 multipunch tool
- Pliers
Safety:
Safety glasses should be worn when using cutting tools. Use caution when using impact tools because they have sharp blades.

Step 1 Cable Preparation
Determine the position on the 110 block that will be used to cross-connect the cable. Since a four-pair cable is being used for the cross-connecting, positions are determined by counting four pairs from the left end of the block. For example, position 1 would be the first four pairs, position 2 would be the second four pairs, and so on. Label the cable with respect to its position on the block. If the plan is to terminate the cable on position 3, use the labeler and pen to number the cable “#3”.

Now that the cable has a unique label, the sheathing will need to be removed without causing any damage to the conductors.

Step 2 Fan the Conductors
Separate and fan out the conductor pairs without untwisting the wires. Place the wires one pair at a time into the termination points 7-10 cm (2-3 inches) from the end of the wires. This will place the two wires in the correct position to be punched down while ensuring that the twisting continues up to the point of termination. Use the proper color-coding scheme, which is white/blue, white/orange, white/green, and white/brown. Make sure that the tip colored wire is placed to the left and the ring to the right.

Step 3 Punch Down
Place the single wire punch down tool over the wire that will be punched. Be sure that the blade will only cut off the end of the wire. The cutting edge of the blade should be facing the direction to be cut.

Press firmly on the impact tool until it clicks. This will ensure that the wire has been punched down all the way and that the excess wire has been cut. Do not hit the tool to punch down the wires.

Step 4 Inspection
Look carefully at the punched down cable. Approximate the length of the wires that are untwisted? ________________________

What is the maximum allowable untwist length? ________________

How much of the pairs are exposed?

How many Category 5e cables can be terminated in a single row of a 110 block? __________
Part 3: Terminating a Category 5e Cable on a Category 5e Patch Panel

Estimated Time: 20 minutes
Number of Team Members: one to four

Lab Objectives:
- Terminate a Category 5e cable on a Category 5e patch panel.
- Proper use of the 110 punch-down tool.
- Proper use of the cable stripper.

Overview:
In order to cross-connect patch panels, wires must be properly punched down on a Category 5e patch panel. It is important to ensure that each punch-down is executed correctly to ensure proper connectivity.

A Category 5e patch panel is a device that is used to terminate wires in a central location. Cables from local data and voice networks are collected in one patch panel, and cables from the outside are collected in a separate panel. These two panels provide a way to connect the two collections of wires in order to supply connectivity from outside the building all the way to the desktop. This system of wire management allows for organization and quick changes.

In this lab, a Category 5e cable will be terminated on a patch panel. The other end of the cable will be terminated on a 110 connection block and a 110 to RJ-45 adapter cable will be used. Students will test the cable they installed.

Preparation:
The instructor or lab assistant will designate the location of the punch-down for each student at the top of this sheet indicating the rack, row, and position on the patch panel.

Tools and Resources:
- Category 5e patch panel
- 1.2 m (4 ft) of Category 5e UTP cable
- Wire stripper tool
- Wire snipping tool
- Impact tool with 110 cutting blade
- Safety glasses

Safety:
Remember to always wear safety glasses when punching down wires. This is because the impact tools have sharp blades. Always be conscious of the task being performed to avoid accidental cuts.

**Step 1 Cable Preparation**

Route two cables between the cable between locations using cable management and velcro ties as needed. Remove enough of the sheath to terminate the cable on the patch panels. Leave a small service loop in the vertical cable management at each end.

**Step 2 Insert the Conductors**

Fan out the conductor pairs without untwisting the wires at all.

Follow the label on the rear of the patch panel. Cables will be terminated as T568B.

Make sure to have 8-10 cm (3-4 in.) of extra wire past the termination point and split a twist on the colored tip. The tip color goes to the left and the ring color goes to the right. This will ensure that the twisting continues up to the point of termination. It is very important that the twists in the wire remain as tight as possible up to the point of termination.

The maximum untwist length for Category 5e cable is 1 cm (0.5 in.), but 3 mm (0.125 in.) is preferred.

To make sure the termination of the cable looks professional, it is best to begin the insertion of the conductors with the center pairs and work towards the outside termination points. This will provide the outside wire pairs a minimal and equal amount of exposure.

**Step 3 Punch Down**

Note: If the patch panel is punched down on too hard, the circuit board inside may be damaged. The single wire impact tool with the 110 blade only should be used for this application. The impact tool should be set on the “lo” setting. **Never use the multipunch tool when terminating on a patch panel**
Position the impact tool over the wire with the blade facing toward the end of the wire and press firmly on the impact tool until it clicks. Do not hit the tool with the hand to punch down the wires. With the impact tool set to “lo”, it may be necessary to punch the wire two or three times to insure a proper termination. Follow steps 2 and 3 for the other wire. Gently remove the excess wire. Repeat this step for each pair of wires.

Part 4: Testing the cables from end-to-end

Estimated Time: 10 minutes
Number of Team Members: one to four

Lab Objectives:

- Test the cables from end-to-end in various configurations
- To understand the results of the testing

Preparation:

The three previous steps of the lab.

Tools and Resources:

- Fluke Networks 620 LAN Cable Meter
- Two patch cords
- Two crossover cables

Step 1 Test using Fluke Networks 620 LAN Cable Meter

Will this configuration test as a straight cable, or a crossover cable? __________________ Now test it. Where you correct? ________ Explain why.

__________________
__________________
__________________
__________________

Repair any wiring mistakes.

Step 2 Testing modification

a. Use a patch cord on both ends of this lab and connect to the cable from the chapter 10 Lab. Now test from end-to-end. Will this configuration test as a straight cable, or a crossover cable? ________________ Now test it. Where you correct? ________

Explain why. ______________________________________________________

__________________
__________________

b. Replace one of the patch cords with a crossover cable. Will this configuration test as a straight cable, or a crossover cable? ________________ Now test it. Where you correct? ________
c. Replace the other parch cord with a crossover cable. Will this configuration test as a straight cable, or a crossover cable? __________ Now test it. Where you correct? __________
   Explain why. ______________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________

Part 5: Create the labels cables and install them.

Step 1: Develop the label for the 25-pair cable
   Consult with the other team after developing your first draft below:
   
   Final version:
   
   Install it.

Step 2: Develop the label for the 4-pair cable
   Label:
   
   Install it.

Conclusion: __________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
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