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Altium Designer

Advanced Training with Altium 365

Length Tuning Routing with Constraint Manager

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Software, documentation and related materials:

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Length Tuning Routing with Constraint Manager

1 Purpose

Length matching in Altium Designer provides an easy method for matching lengths for critical high-speed signals. Length matching can be performed between signal nets, differential pairs, and signals of a differential pair. Lengths can be matched to a length rule, a routed length, or a manually entered target value.

In this exercise, you'll tune matched lengths to a targeted length and a tolerance to nets within the same differential route class. The Differential Pair Class, REC_DIFF needs to have a routed length between 2100 and 2200 mil total length. The length matching needs to be 10mil between legs of a differential pair and 100 mils between pairs.

2 Shortcuts

Shortcuts used when working with Length Tuning Routing with Constraint Manager

F1	Help
D » R	Constraint Manager (PCB)
D » G	Constraint Manager (SCH)
T » D	Open the DRC
U » P	Interactive Diff Pair Length Tuning
Shift+G	Toggle Tuning Gauge On / Off
U » R	Interactive Length Tuning
CTRL+S	Save Document
During length tuning it is possible to change the properties of the tuning using:	
1 and 2	Change Miter
3 and 4	Spacing
',' and '.'	Amplitude

Note: Before continuing with this module, we recommend to do module *Creating Classes from Schematic with Constraint Manager* first. Module *Creating Classes from Schematic with Constraint Manager* includes a general overview of the *Constraint Manager*.

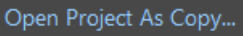Caution: The *Constraint Manager* is only available if you use Altium Designer with a professional subscription. Note that the *Constraint Manager* isn't supported with the Altium Designer standard subscription. For details, please see our [Online Documentation](#).

Caution: Using the *Constraint Manager* replaces the functionality of defining Rules and Classes with Directives at the schematic for nets.

3 Preparation

1. Close all existing projects and documents.
2. Next, create a copy of the Training Project: `Length Tuning Routing with Constraint Manager.`
3. Select **File » Open Project…** to open the *Open Project* dialog.
4. Enable the folder view button .
5. Navigate to the predefined Training Project `Length Tuning Routing with Constraint Manager (Top\Projects\Altium Designer Advanced Training Course\...).`
6. Select **Open Project as Copy…** `Open Project As Copy...` .
7. In the new dialog *Create Project Copy:*
   a) Add your name to the project name: `Length Tuning Routing with Constraint Manager – [Your Name].`
   b) Add a description: `Altium Advanced Training – [Your name].`
   c) Open the *Advanced* section.
   d) Select the **Ellipsis Button** ⋯ from the *Folder* configuration to open the *Choose Folder* dialog.
      i) Select the folder with your name: `Project\For Attendees\[Your name].`
      ii) Select **OK**.
   e) Change the **Local Storage** path if needed.
   f) Select **OK** to create the copy.
8. Wait until Altium Designer creates the copy of the project and opened the Project for you in the *Projects* panel, this may take up to 1 minute.

> Hint: For details how to copy the predefined training project, see module *03 Getting started - Opening a Project*.

> Note: Due to Length Limit limitations, the files names in the workspace may differ from the names used in this document. We use CM for Constraint Manager and IP for Impedance Profile.

4 Interactive Length Tuning

4.1 Design Rules

9. Open the `Length Tuning Routing with CM.PcbDoc` document from the *Projects* panel.

10. From the **Design** menu, select **Constraint Manager**. This can also be done using the **D » R** shortcut keys.

> Hint: For details about Constraint Manager GUI, the difference between Constraint Manager opened from SCH (Clearances , Physical , Electrical) and Constraint Manager opened from PCB (Clearances , Physical , Electrical , All Rules), see the Module `Creating Classes from Schematic with Constraint Manager`.

11. Select *All Rules* [All Rules] view.

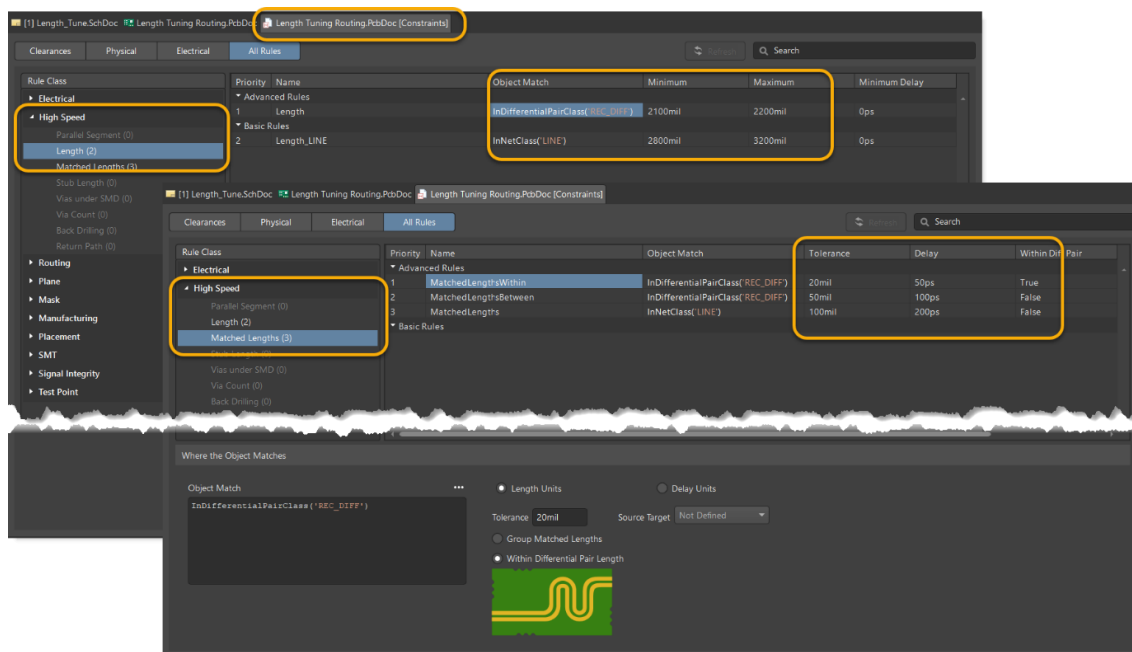12. Scroll down and expand the *High-Speed* rule category as shown in Figure 1.

Figure 1. High-Speed Design Rules

13. Expand and select the various rules listed under the *Length* and *Matched Length* rule categories to see what rules will be applied during the Interactive Length Tuning.

    a) Length:
        Absolute Length for the Differential Pair signals in the predefined Class between 2100 mil and 2200mil.
        Absolute Length for the Line signals in the predefined Class between 2800mil and 3200mil.

    b) Matched Length:
        Allowed length difference between the Line Signals in the predefined Class 100mil.
        Allowed length difference between the Differential Pairs in the predefined Class 50mil.
        Allowed length difference between P and N of a Differential Pair in the predefined Class 20mil.

14. Close the *Constraints Manager* **without** saving.

4.2 Design Rules Check (DRC)

You will now run the Design Rule Check to see if there are any design errors in regard to the length of our signals.

15. From the **Tools** menu, select **Design Rule Check...**

16. Select the **Run Design Rule Check...** button in the lower left corner of the dialog.

17. The *Messages* panel will appear, along with a report showing all of the Length Rule Violations in your design. Note that there are several length and matched length violations.

18. Feel free to open the *PCB Rules And Violation* panel to check the DRC violations.

19. Close the *Design Rule Verification Report* as well as the *Messages* panel and return to the PCB document.

4.3 Length Tuning for LINE Signals

20. Open the *PCB* panel.

21. From the drop-down menu at the top of the *PCB* panel, select **Nets**.

22. In the *Net Classes* section, select LINE.

23. In the *Nets* section, you will see all 6 LINE signals, along with their *Signal Length*, as shown in Figure 2. The *Signal Lengths* are highlighted in orange because they don't meet the desired length that is determined in the design rule.

Figure 2. LINE signals and lengths

24. From the **Route** menu, select **Interactive Length Tuning**, or use the **U » R** shortcut keys. Alternatively, you can access this command from the ActiveBar.

25. Select one of the traces in the LINE class to start adding accordions.

26. During the tuning process, hit the **TAB** key to bring up the *Properties* panel.
    a) For the *Source*, under the *Target* section*, select* **From Rules**, as shown in Figure 3.
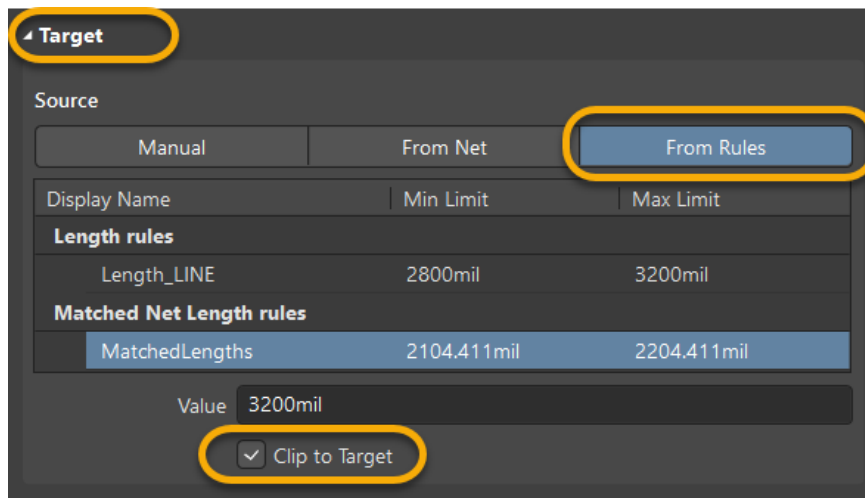   b) Check that the option **Clip to Target** is active.

Figure 3. Source length for signal length tuning

27. Select the **Pause** icon or hit **Enter** to continue placing the accordions.

28. Move your cursor until you see the length gauge turn green. Then, left-click to complete the tuning.

29. With the tuning command still on your cursor, continue to length tune the remaining 5 nets.

30. Your end result should look similar to Figure 4. The *Signal Lengths* in the *PCB* panel should no longer have an orange highlight, showing that you're adhering to the design rule.
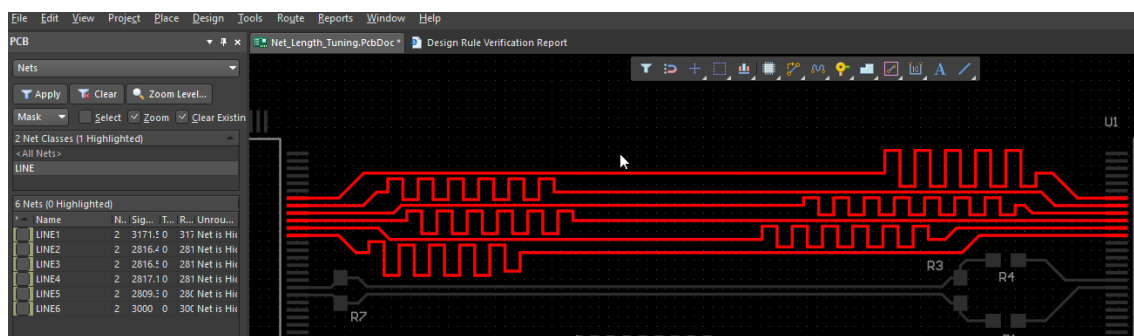

Figure 4. Staggered tuning on Line tracks

Caution: The target length shouldn't be shorter than the original length, since the routed track can be made longer by adding deviations, but it can't be made shorter.

4.4 Length Tuning for Differential Pairs

31. Open the *PCB* panel, if not already opened.

32. Select the **Differential Pairs Editor** from the drop-down menu.

33. Ensure the **Zoom** checkbox is checked. The zoom level can be adjusted by selecting the **Zoom Level…** button and adjusting the slider.

34. Select the REC_DIFF differential pair class to zoom to the two pairs on the PCB, Figure 5. Note that the *Average Lengths* are shown for each pair.
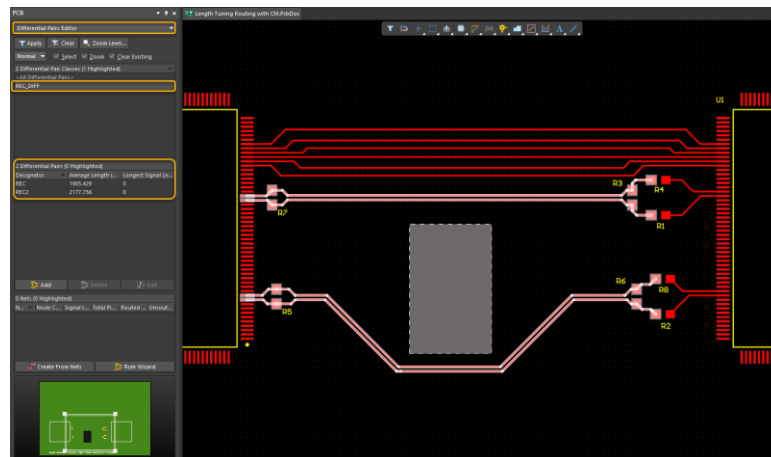

Figure 5. Differential Pairs Editor – PCB panel

35. From the **Route** menu, select **Interactive Diff Pair Length Tuning**. Alternatively, you can access this command from the ActiveBar 🔲, or by using the **U » P** shortcut keys.

> Hint: There are 3 different accordion styles to choose from. Accordion, Trombone, and Sawtooth. To change the accordion style, hit the **TAB** key before left-clicking on the route to start the tuning process. You will use Accordion later in the exercise.

36. With the crosshair on your cursor, select one of the tracks in the REC differential pair. This is the differential pair near component R7.

37. Press the **TAB** key to pause the length tuning process so that changes can be made in the *Properties* panel.

38. In the *Properties* panel, in the *Target* section, set the *Source* to **From Diff Pairs**, Figure 6.

39. Select the REC2 differential pair. This will ensure the target length will be pulled from that differential pair.
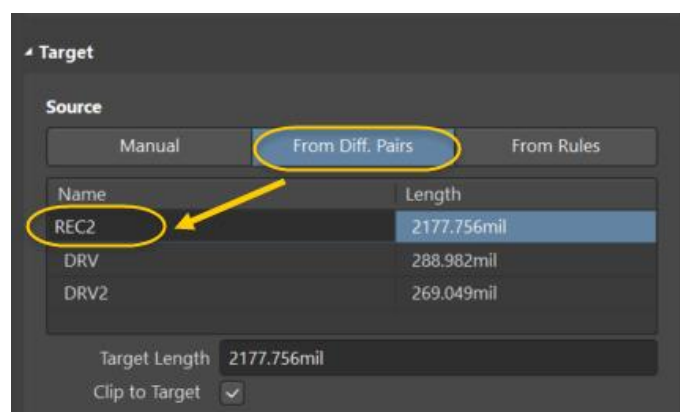

Figure 6. Target length for the differential pair length tuning

40. In the *Pattern* section, set the values for the accordions, as shown in Figure 7 below:

    a) Max Amplitude = `30`

    b) Amplitude Step increment = `10`

    c) Space = `20`

    d) Space Step Increment = `10`

    e) *Style:* Mitered Lines

> Hint: The tuning style must be determined before placing the length tune. If you don't have the Accordion style as the default style, repeat the length tune command and hit the TAB key before placing the tune. This will allow you to change the style.
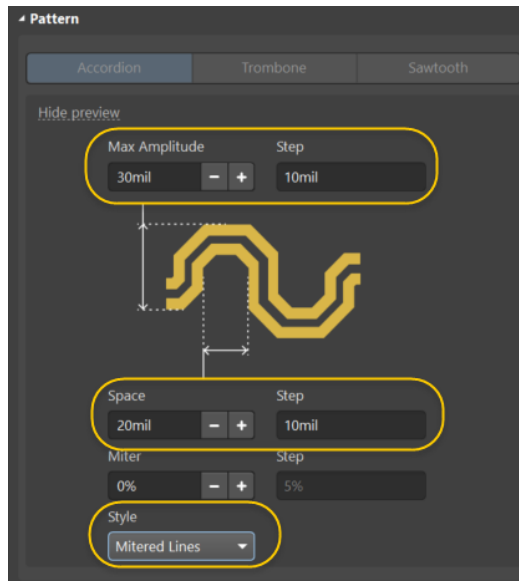

Figure 7. Differential Pair Tuning properties

41. Select the **Pause** icon to return to the length tuning command.

42. Accordions will be added by moving the mouse along the differential pair route until the length tuning gauge turns green. The gauge can be enabled or disabled using **Shift+G** during the tuning process, as shown in Figure 8.
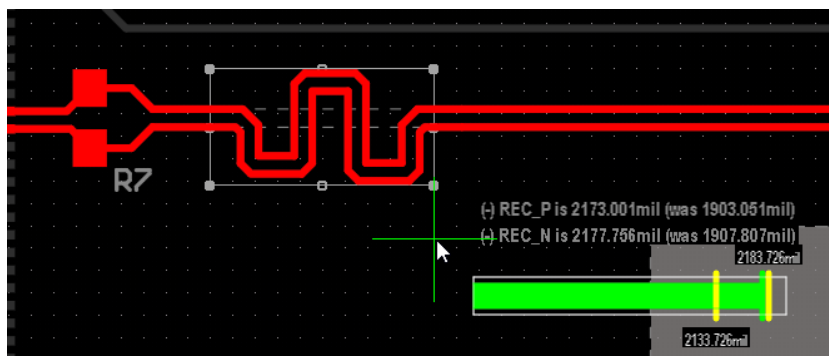

Figure 8. Length Gauge turns green when within tolerance

43. Left-click to commit the added accordions, then right-click to terminate the command.

> Hint: During length tuning, it's possible to change the properties of the tuning using keys:
> **1** and **2:**   Change Miter
> **3** and **4:**   Spacing
> '**,**' and '**.**'   Amplitude

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4.5 Modifying Existing Length Tuning

Updating or removing an existing length tuning is as easy a placing the tuning.

44. Select the length tuning from the Differential Pair. You'll notice that there's a bounding box around it. This is called the Sleeve.

45. Once selected, you'll see the vertex points.

46. Select one of the vertex points to change the size of the Sleeve, Figure 9. By moving the vertex, you change the length of the tuning. Similar to placing a length tuning, you see the length tuning gauge, giving you the information about the current length of the signals.
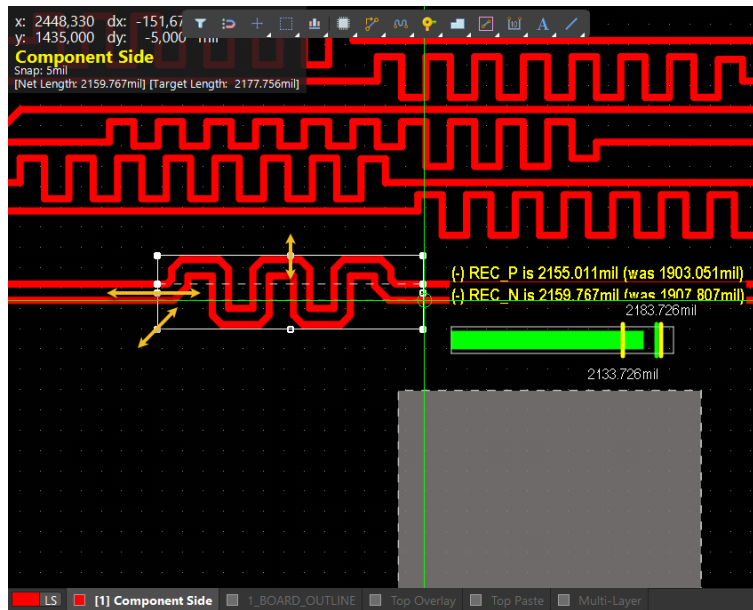

Figure 9. Modify an existing length tuning

47. To rotate the accordion, press and hold **Ctrl**, and rotate the box. If the box is too small to create a length tuning pattern, the Accordion disappears. In such case, try increasing height and length of the box, Figure 10.
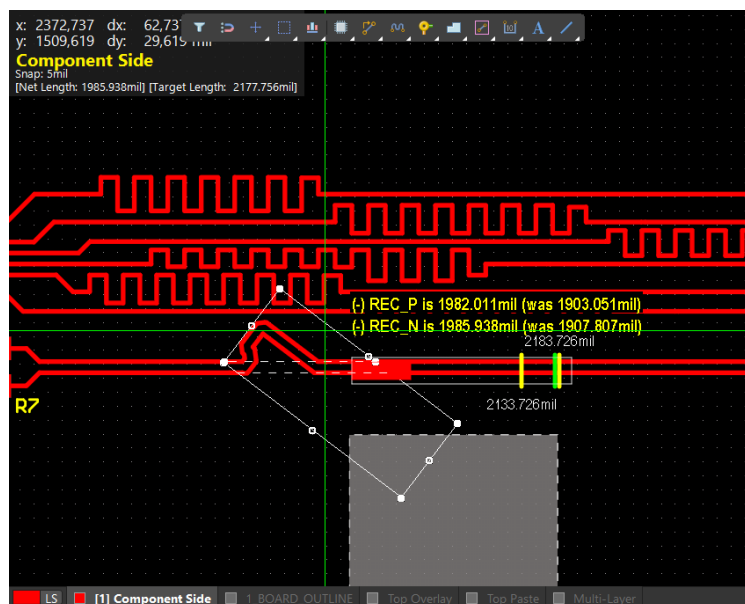

Figure 10. Length Tuning Accordion with a rotation information

4.6 Removing Existing Length Tuning

48. To remove a placed length tuning information, follow the steps below, Figure 11:

   a) Select the length tuning.

   b) Press **DEL** on your keyboard to remove the length tuning.

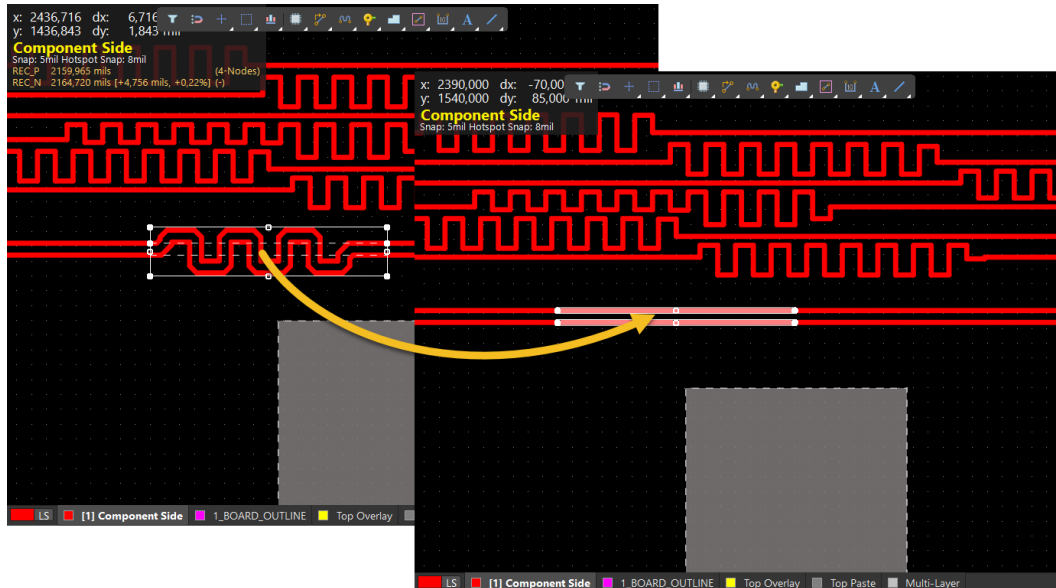   c) The length tuning accordion will be removed and replaced by tracks.

Figure 11. Delete an existing length tuning

49. Place a new accordion to tune the differential pair again. Instead of placing an accordion with the style Mitered Lines, place the accordion with **Mitered Arcs**. Use Figure 12 as reference for the accordion parameter.
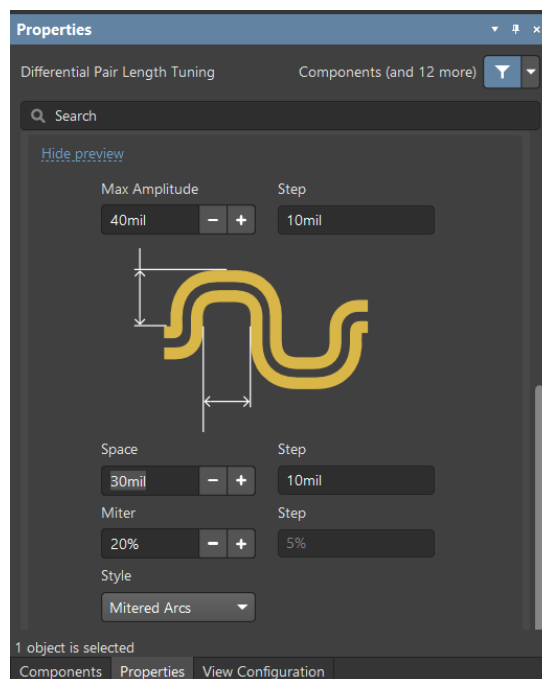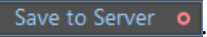

Figure 12. Accordion with Mitered Arcs

Note: In this module, you only place the Accordion pattern. The Trombone pattern will be used in another module of this training.

50. Lastly, run a **Design Rule Check...** from the **Tools** menu. There should no longer be any violations.

51. Save all documents using **File » Save All**.

52. Save the modifications to the server:

    a) In the *Projects* panel, next to the Project name you find the command **Save to Server**
        `Save to Server` ⊙ .

    b) Select **Save to Server**.

    c) In the dialog *Save [Project Name]*,

       i) Add the comment `Length Tuning Routing with Constraint Manager - [Add Your Name] – Finished.`

       ii) Select **OK**.

53. When ready, close the project and any open documents, **Window » Close All**.

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Congratulations on completing the Module!

Length Tuning Routing with Constraint Manager

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