

Altium

QUICK GUIDE

Properties Panel - Tuning



Max. Amplitude
0.532 mm

Tooth Width
0.254 mm

Step
0.254 mm

Miter
25%

What is tuning used for?


Most high-speed interfaces contain parallel buses that operate at high frequencies: data buses, address buses, and other.

There are some examples of such interfaces: USB3.0, PCIE, DDR3/DDR4 memory interfaces and other.

For such interfaces to work properly it is necessary that the signals from the transmitter to the receiver come within some limited time mismatch. This problem is solved by aligning the lengths of group of tracks with some accuracy. This is done by adding a delay to the shorter tracks in the form of accordions, trombones or saw teeth. In addition, alignment is used to match the phases of signals within a differential pair.

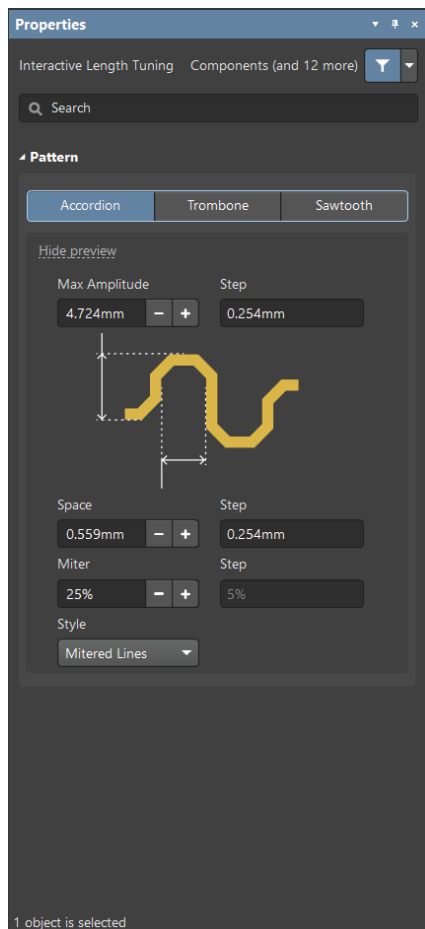
Tuning tools

Altium Designer has two tools for alignment:

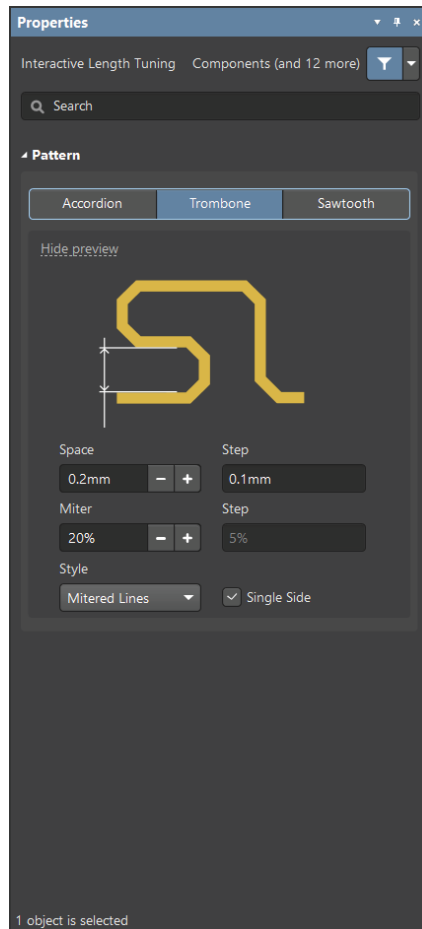
 **Interactive Length Tuning** – for single tracks;

 **Interactive Diff Pair Length Tuning** – for differential pairs.

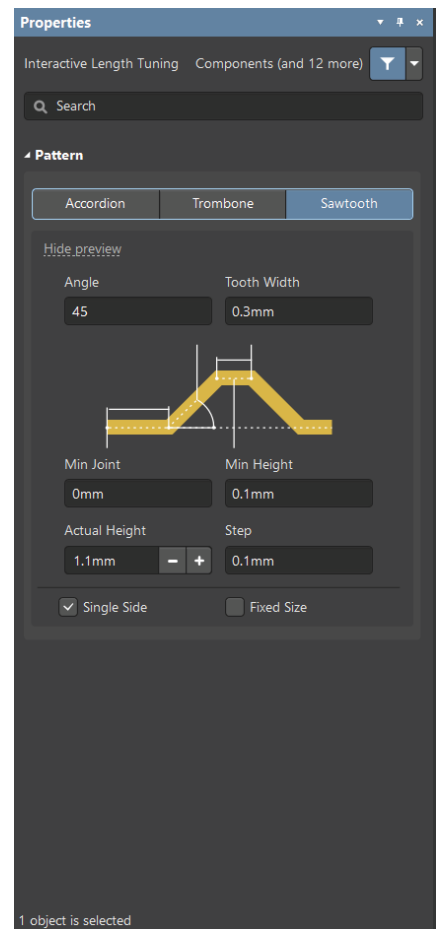
After you run the tool, there are three length adjustment patterns to choose from in the Properties panel.



Accordion



Trombone



Sawtooth

Accordion pattern

Accordion is the most commonly used net length tuning pattern. The Properties panel is used to adjust shape, amplitude and pitch of the accordion segments. You can change all these parameters dynamically with the hotkeys during creating.

The diagram illustrates four variations of the accordion pattern, each with a callout pointing to a specific parameter in the Properties panel:

- Amplitude:** Points to the height of the wave segments.
- Space:** Points to the horizontal distance between the peaks of the wave segments.
- Miter:** Points to the sharpness of the corners where the wave segments meet.
- Style:** Points to the 'Mitered Lines' dropdown menu in the Properties panel.

The Properties panel screenshot shows the following settings for the Accordion pattern:

- Max Amplitude:** 4.724mm
- Step:** 0.254mm
- Space:** 0.559mm
- Miter:** 25%
- Style:** Mitered Lines

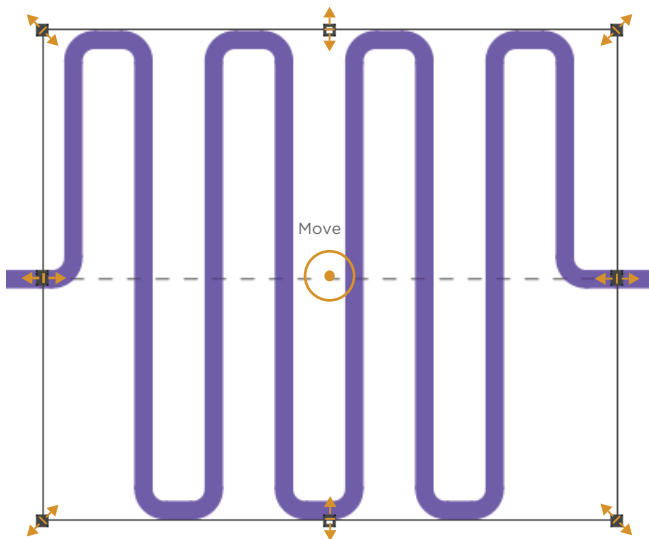
SHORTCUTS

| | | |
|------|-------|-------|
| Step | Space | Style |
| - + | 3 4 | SPACE |
| , . | 1 2 | |

Accordion pattern

Additional features when working with the placed accordion:

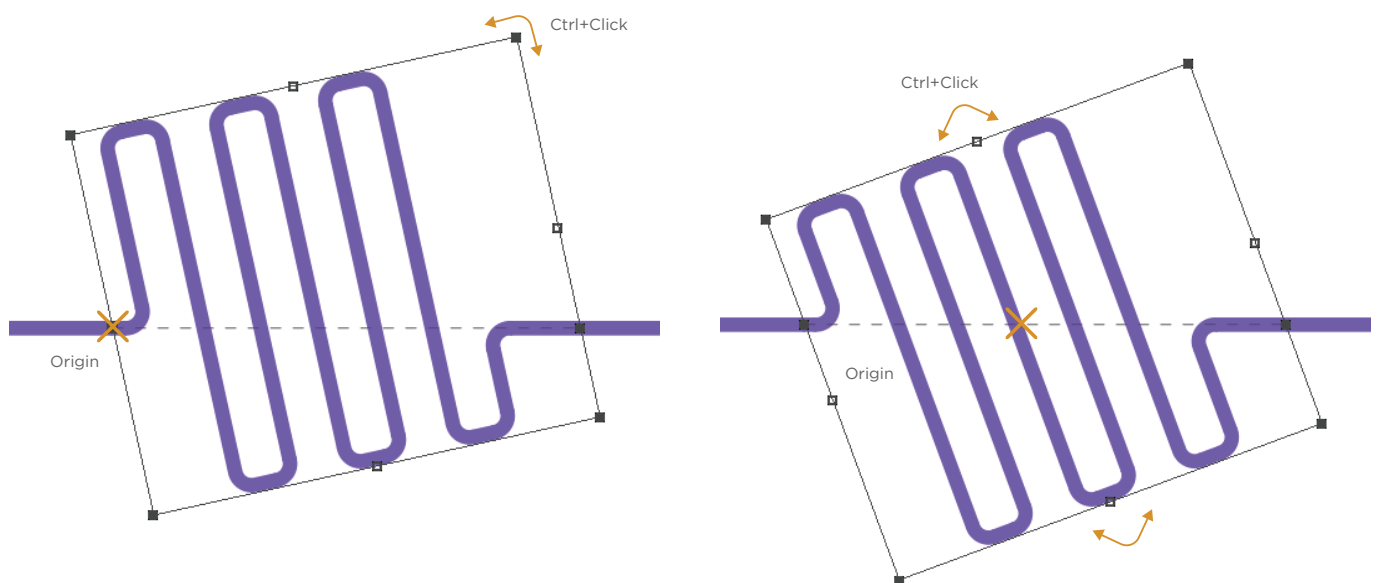
MOVE/RESIZE



Select the accordion, and then left-click inside the framework for moving along the track. Move sides or frame corners to resize.

ROTATION

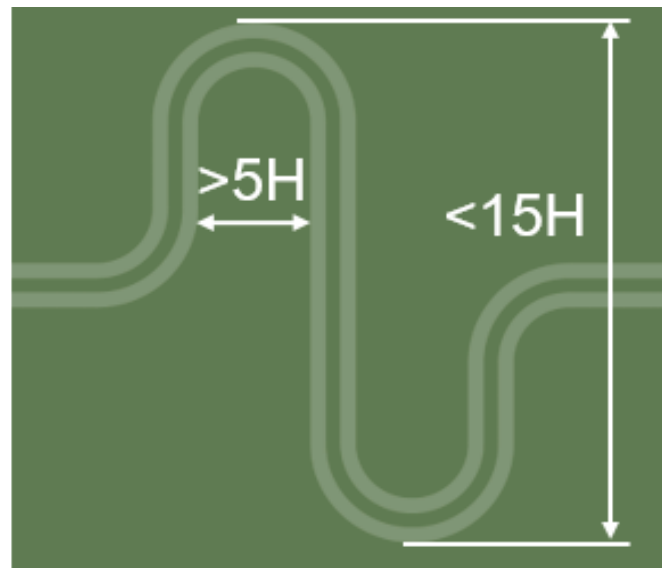
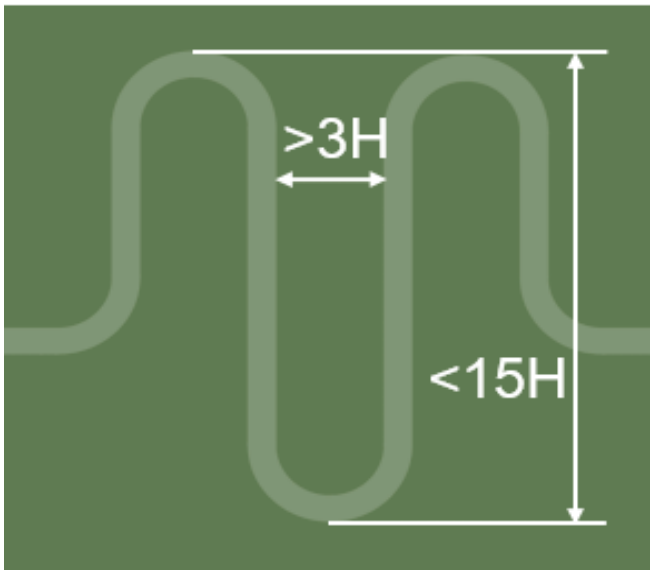
Press R while rotating to turn on a multiple of 45 degrees.



Accordion pattern

Practical guidelines for Accordion pattern application:

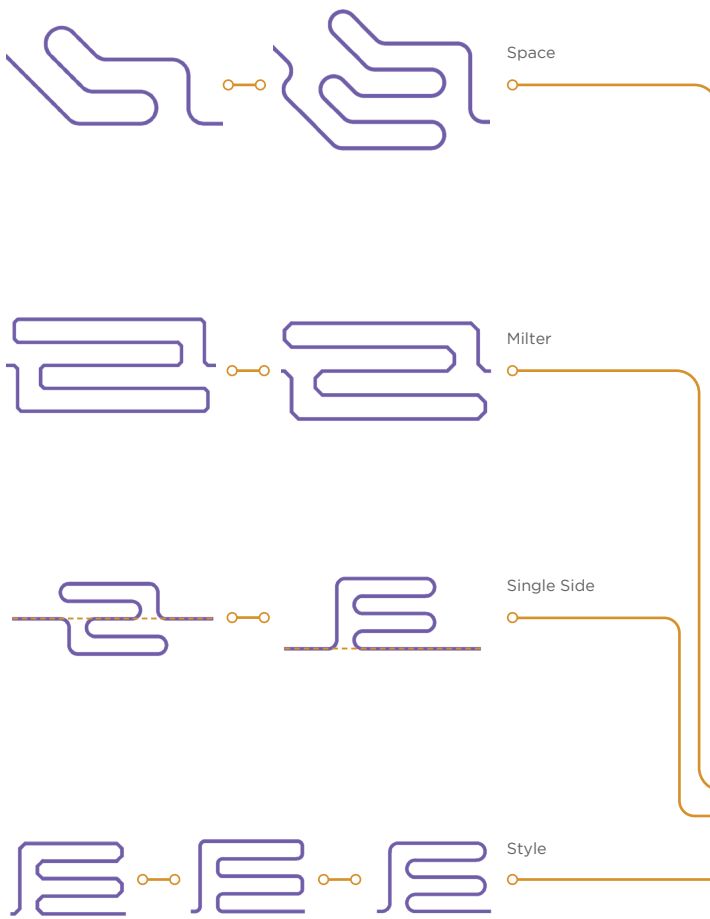
- Preferred for high-speed signals and differential pairs;
- The optimum segment clearance must be $>3H$, for differential pairs $>5H$. The maximum length of segments is no more than $15H$. This will reduce the interaction of electromagnetic fields of neighboring segments.
- It is preferable to use the Mitered Arcs or Rounded rotation styles.



H is the track lift height above the nearest reference plane.

Trombone pattern

Trombone uses the concept of tuning sleeve and can be positioned on track bends even in tight places to fill the space efficiently. In the Properties panel you can configure shape, pitch and position of trombone segments. You can also dynamically change a number of parameters using hotkeys directly during construction.



Properties

Interactive Length Tuning Components (and 12 more)

Search

Pattern

Accordion **Trombone** Sawtooth

Hide preview

Space: 0.2mm - + Step: 0.1mm

Miter: 20% - + Step: 5%

Style: Mitered Lines Single Side

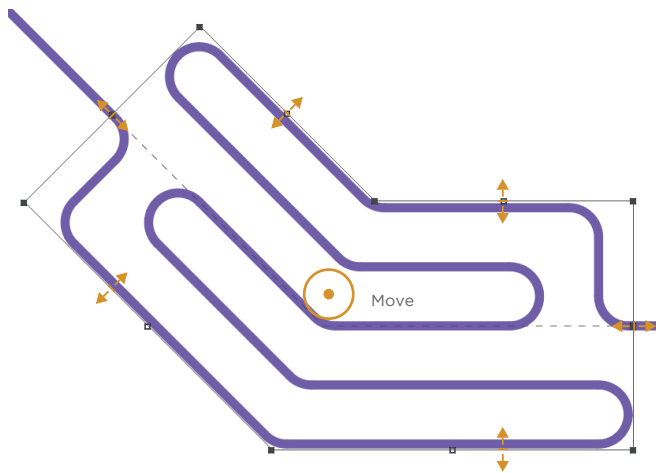
SHORTCUTS

| | | |
|-------|-------|-------------|
| Step | Space | Style |
| - + | 3 4 | SPACE |
| Miter | | Single side |
| 1 2 | | S |

Trombone pattern

Additional options when working with the placed trombone:

MOVE/RESIZE

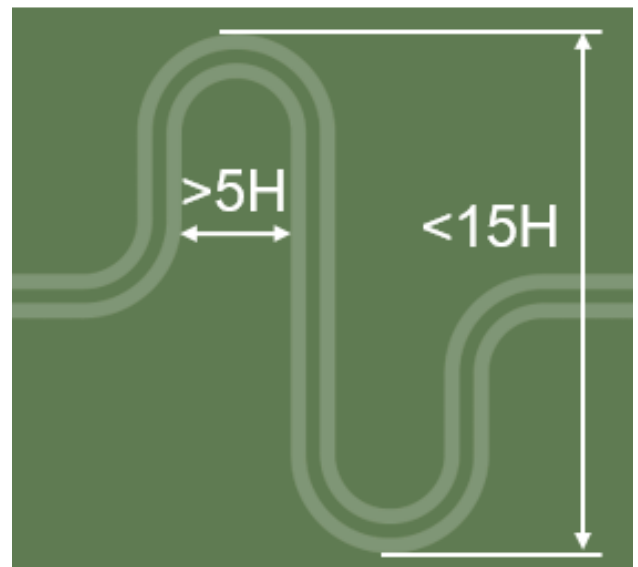
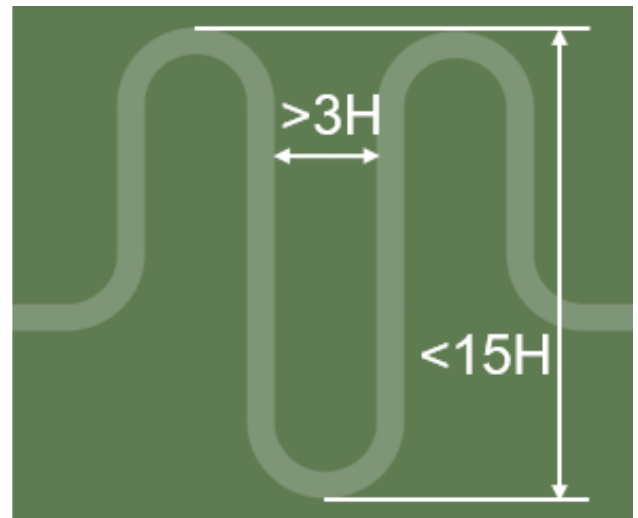


Different modes of moving and shape changing are available by using the **Ctrl** and **Shift** keys

Trombone pattern

Practical guidelines for Trombone pattern application:

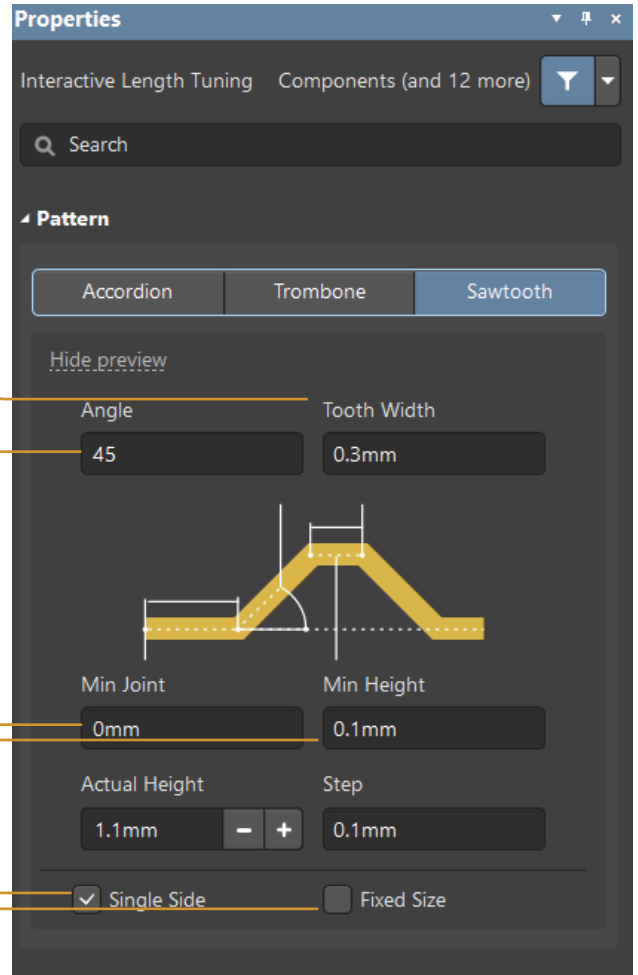
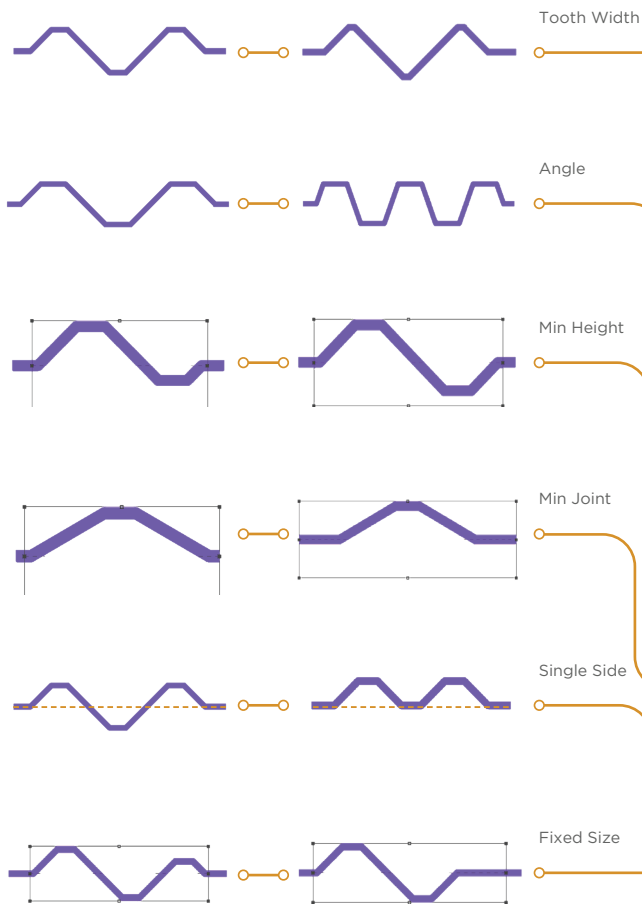
- Useful in tight places, in case of obstacles;
- The optimum segment clearance must be $>3H$, for differential pairs $>5H$. The maximum length of segments is no more than $15H$. This will reduce the interaction of electromagnetic fields for neighboring segments.
- It is preferable to use Mitered Arcs or Rounded styles.
- Not recommended for tuning track phase and differential pairs.



H is the track lift height above the nearest reference plane.

Sawtooth pattern

Sawtooth uses the tuning sleeve concept and can be placed on the track bends. It helps to tune the length more precisely. In the Properties panel you can configure angle, width, height and start of the «sawtooth». You can also dynamically change the height by using the «hotkeys» directly during construction.



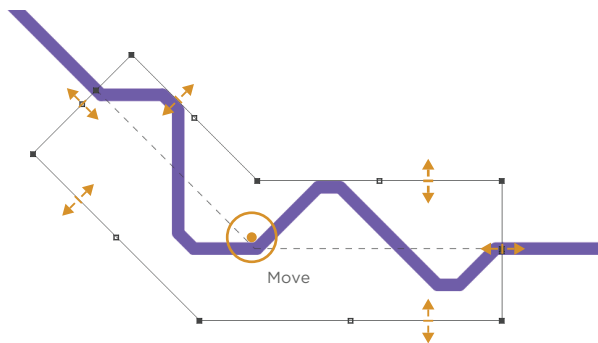
SHORTCUTS



Sawtooth pattern

Additional options when working with Sawtooth pattern:

MOVE/RESIZE



Different modes of moving and changing shape are available by using the **Ctrl** and **Shift** keys

Sawtooth pattern

Practical guidelines for Sawtooth pattern application:

- It is useful in tight places, between via arrays;
- Preferred for signal phase alignment in differential pair.
- Acute angles for high-speed signals are not desirable.
- Maximum clearance in differential pairs must be $<2S$, the tooth width $<3W$. S is the clearance between tracks, W is the width of track in differential pair. This will minimize the interference of tracks in a pair.
- Place the saw teeth as close as possible to where the misalignment occurred.

