



**FUTURE RETRO**

XS Synthesizer  
Calibration Procedure

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## Calibration Procedures

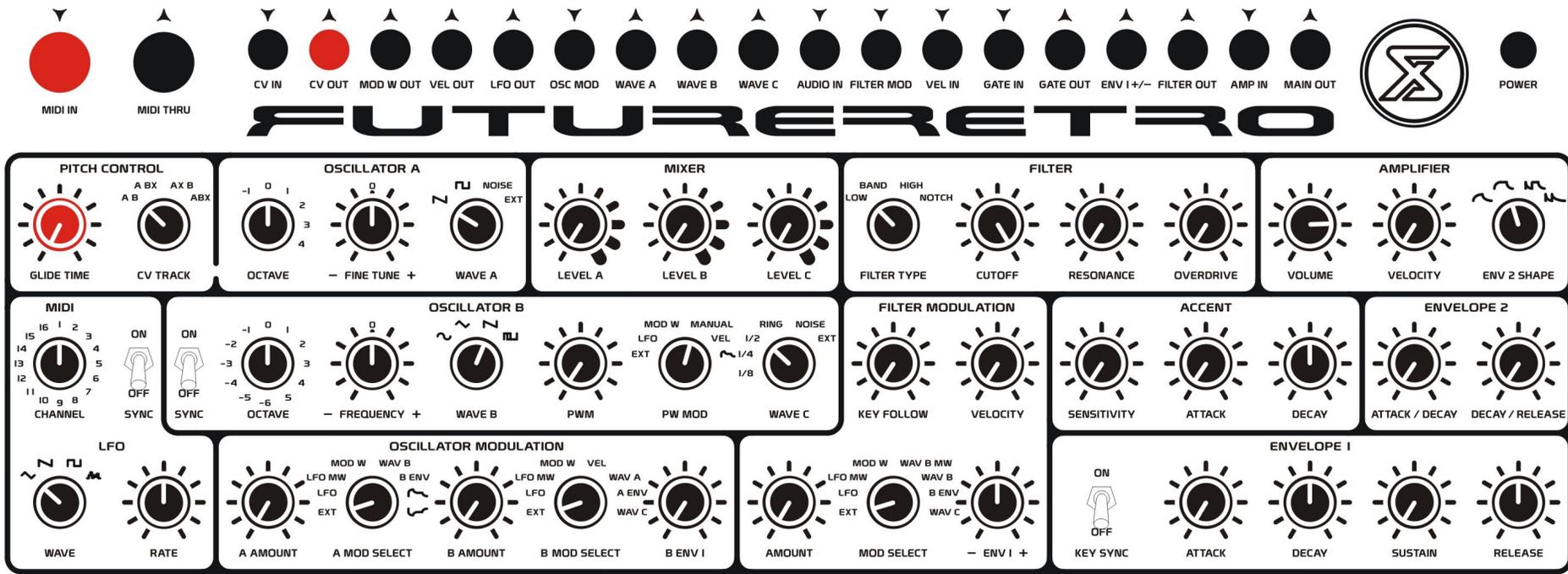
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**NOTE:** Due to the nature of the analog circuits used in the XS, the unit should be turned on for at least 20 minutes before the testing and calibration procedure is performed. This allows the circuits to reach their typical operating temperature, and will provide a much more accurate results.

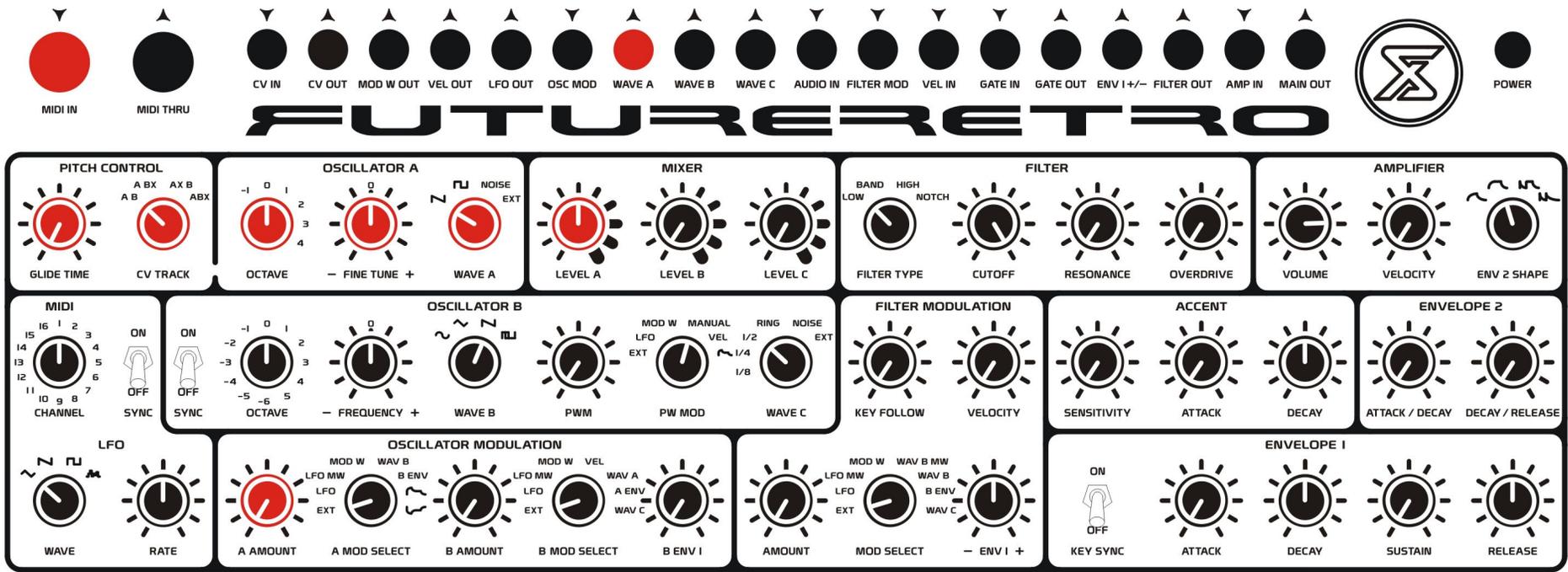
**WARNING:** Always disconnect the power of the unit when opening it up and making connections. Always be sure to ground yourself when handling the exposed internal components of the XS PC boards, to eliminate the possibility of electrostatic shock to components. Failure to do so may damage the unit beyond repair.



**Step 1, Calibrating the V/Oct CV OUTPUT:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the CV OUT jack to a voltmeter (positive terminal will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated.

Play note C1 on the MIDI keyboard, and note the current voltage being output. Play note C6 on the MIDI keyboard, and adjust trimmer TR1 so the CV output is now +5v higher than the voltage generated for note C1. Play note C1 again just to verify that it's voltage has not changed since adjusting TR1. If it has, note it's new voltage and then play note C6 again to fine tune the output to +5v higher than C1. Voltage trimming should be accurate within 1/1000th of a volt.



## Step 2, Calibrating the Scale of Oscillator A:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the WAVE A output jack to an oscilloscope (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated.

Play note C1 on the MIDI keyboard, and adjust the oscilloscope to display 1 period of the sawtooth waveform across the horizontal width of the display. Note where the waveform ends, as this will be our reference when tuning the other octaves. Play note C2 on the MIDI keyboard, and adjust trimmer TR2 until 2 periods of the waveform are displayed within the reference distance. Play note C3 on the MIDI keyboard, and adjust trimmer TR2 until 4 periods of the waveform are displayed within the reference distance. Play note C4 on the MIDI keyboard, and adjust trimmer TR2 until 8 periods of the waveform are displayed within the reference distance. Play note C5 on the MIDI keyboard, and adjust trimmer TR2 until 16 periods of the waveform are displayed within the reference distance. And finally, play note C6 on the MIDI keyboard, and adjust trimmer TR2 until 32 periods of the waveform are displayed within the reference distance.

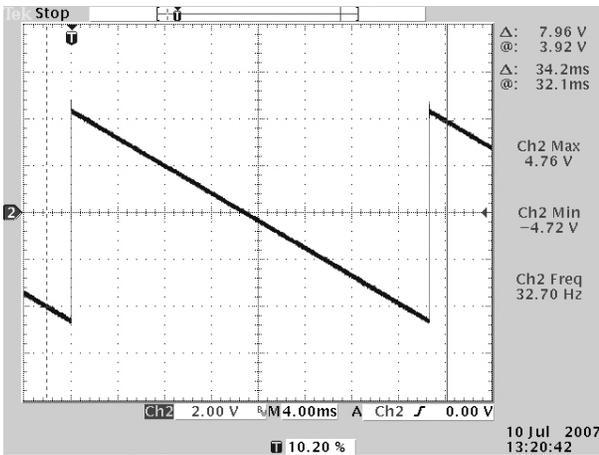
Now play notes C1, C2, C3, C4, C5 and C6 on the MIDI keyboard, while doing so make sure that ends of these saw waveforms are lining up perfectly with one another, at the defined reference distance.

While calibrating this control you can monitor the audio by connecting the Main Output of the XS to the input of your sound system if you wish to hear the adjustments you make.

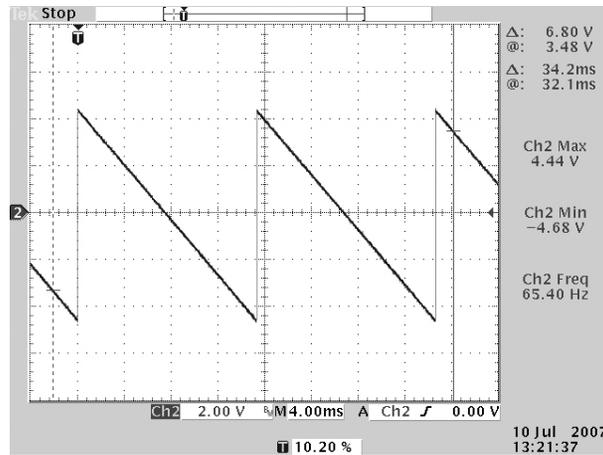
### Alternative Method:

If you do not have access to an oscilloscope, you could substitute the oscilloscope with a digital frequency counter. In this method you would connect the WAVE A output jack to the input of your frequency counter. And select the square waveform for WAVE A. Play note C1 and note the frequency generated. Play note C2 and adjust TR2 until the frequency is now twice that of note C1. Play note C3 and adjust TR2 until the frequency is four times that of note C1. Play note C4 and adjust TR2 until the frequency is 8 times that of note C1. Play note C5 and adjust TR2 until the frequency is 16 times that of note C1. And finally, play note C6 and adjust TR2 until the frequency is 32 times that of note C1.

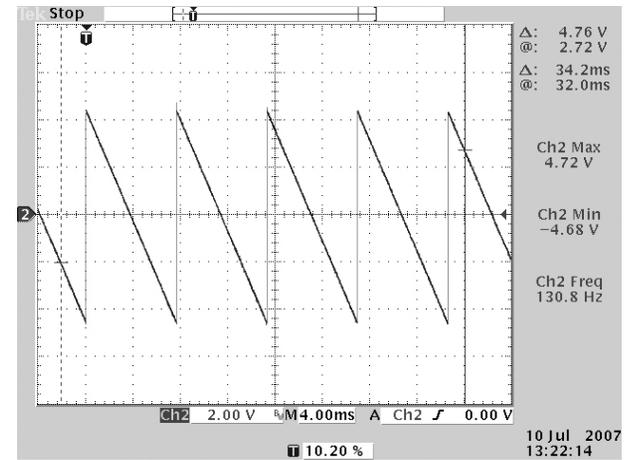
## Step 2, Oscillator A Scale Calibration:



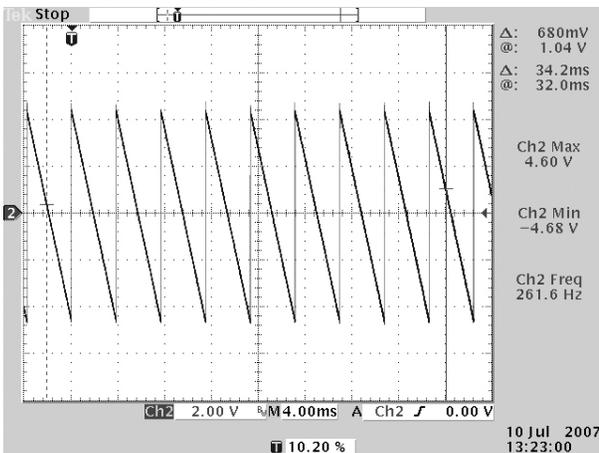
Playing C1 on MIDI keyboard



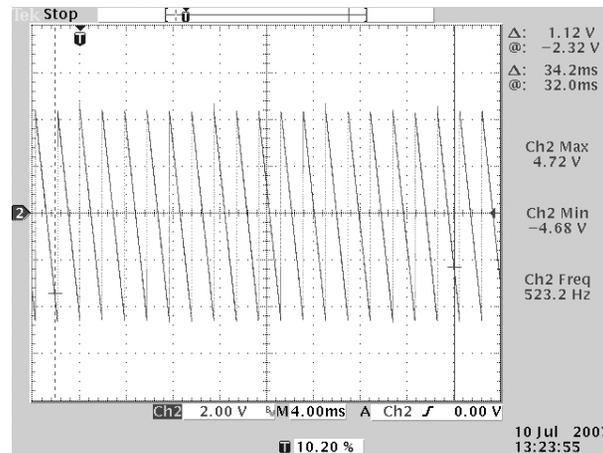
Playing C2 on MIDI keyboard



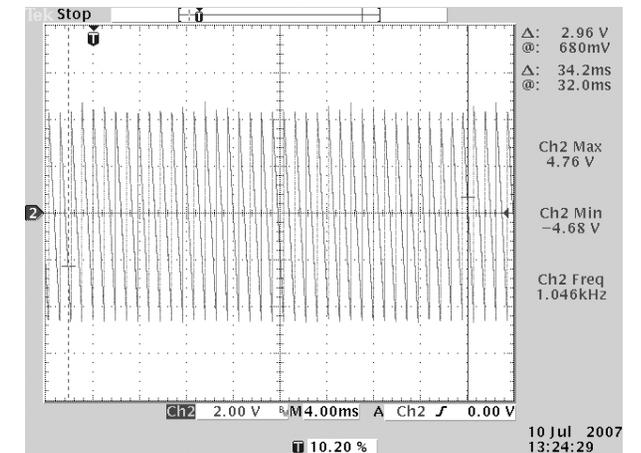
Playing C3 on MIDI keyboard



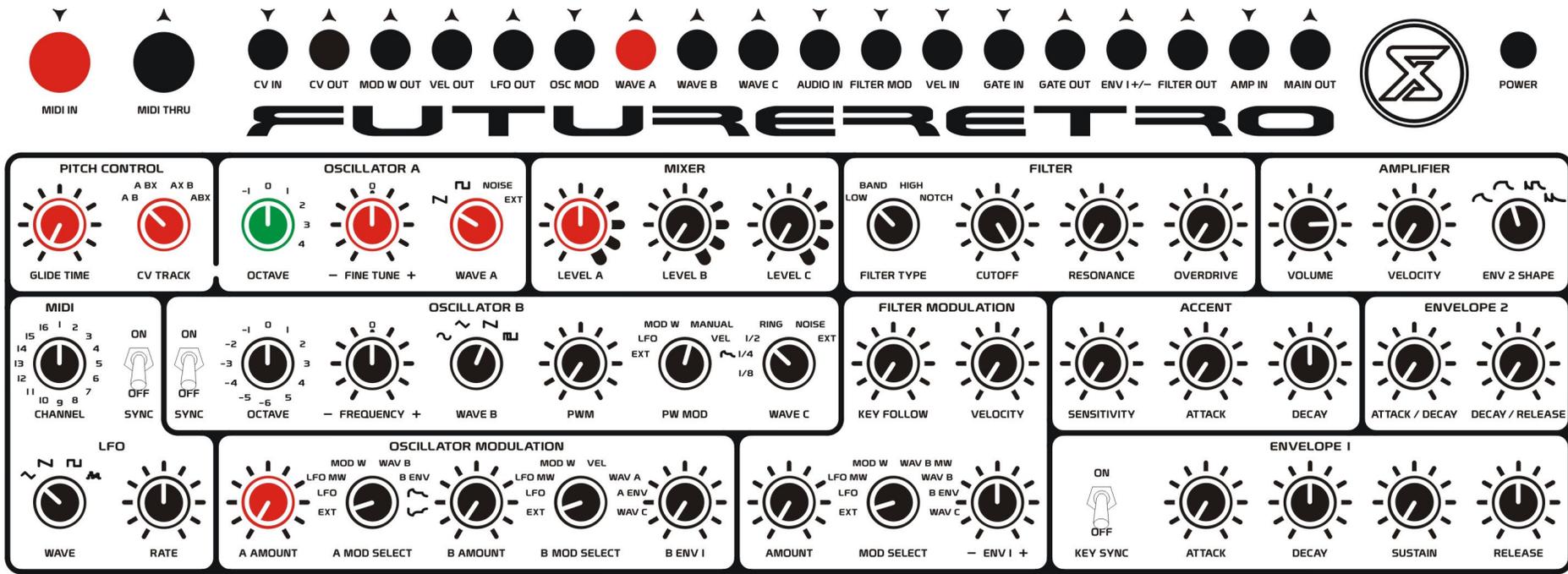
Playing C4 on MIDI keyboard



Playing C5 on MIDI keyboard



Playing C6 on MIDI keyboard



### Step 3, Calibrating the Octave Control of Oscillator A:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the WAVE A output jack to an oscilloscope (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated. The control shown in green is the one we will be adjusting. It may also be helpful to connect a digital tuner to the FILTER OUT jack to verify these octaves are in tune.

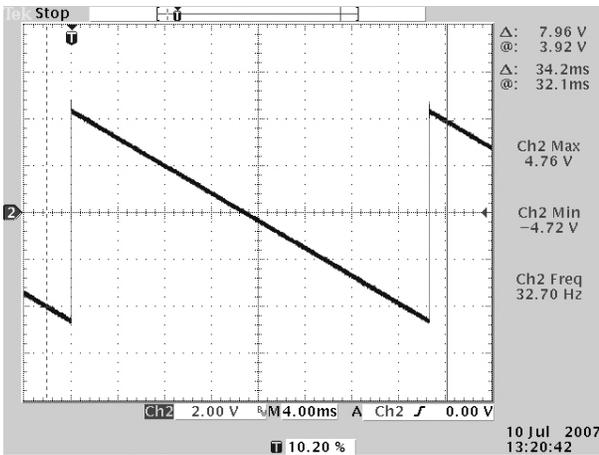
Play note C1 on the MIDI keyboard, and make sure the OCTAVE control for Oscillator A is set to its "0" setting. Adjust the oscilloscope to display 1 period of the waveform across the horizontal width of the display. Note where the waveform ends, as this will be our reference when calibrating the other octave divisions. Now select the OCTAVE "1" setting for this control and adjust trimmer TR3 so that 2 periods of the waveform are displayed within the reference distance. Select the OCTAVE "2" setting for this control and adjust TR3 so that 4 periods of the waveform are displayed within the reference distance. Select the OCTAVE "3" setting for this control and adjust TR3 so that 8 periods of the waveform are displayed within the reference distance. Select the OCTAVE "4" setting for this control and adjust TR3 so that 16 periods of the waveform are displayed within the reference distance. Now you can rotate the OCTAVE control quickly through settings 0 through 4, while doing so make sure that ends of these waveforms are lining up perfectly with one another, at the defined reference distance. If not, you may need to make slight adjustments to TR3 so that the waveforms are generating perfect octaves.

While calibrating this control you can monitor the audio by connecting the Main Output of the XS to the input of your sound system if you wish to hear the adjustments you make.

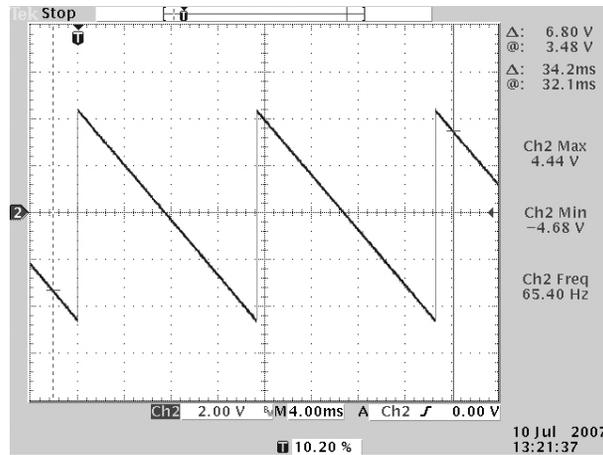
### Alternative Method:

If you do not have access to an oscilloscope, you could substitute the oscilloscope with a digital frequency counter. In this method you would connect the WAVE A output jack to the input of your frequency counter. And select the square waveform for WAVE A. Play note C1, and set the OCTAVE control for Oscillator A to its "0" setting, and note the frequency being generated. Select the OCTAVE "1" setting and adjust TR3 until the frequency is 2 times the frequency produced by the "0" setting. Select the OCTAVE "2" setting and adjust TR3 until the frequency is 4 times the frequency produced by the "0" setting. Select the OCTAVE "3" setting and adjust TR3 until the frequency is 8 times the frequency produced by the "0" setting. Select the OCTAVE "4" setting and adjust TR3 until the frequency is 16 times the frequency produced by the "0" setting.

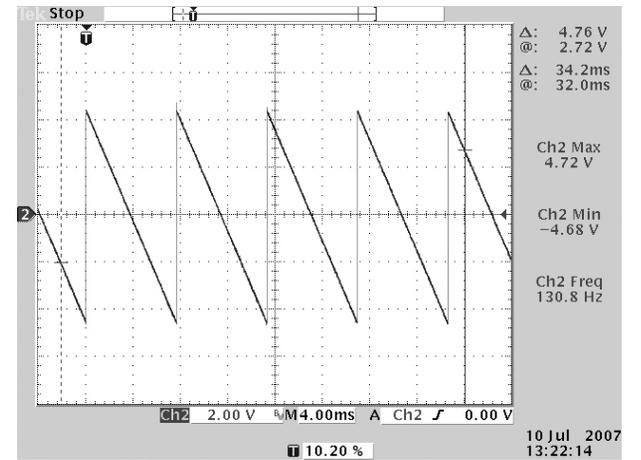
### Step 3, Oscillator A Octave Calibration:



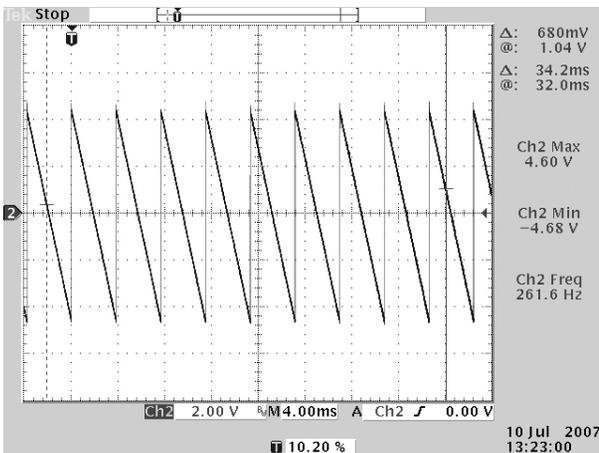
Octave control set to 0



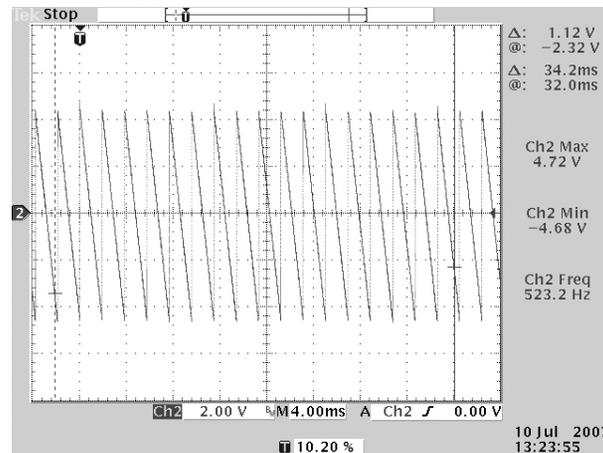
Octave control set to 1



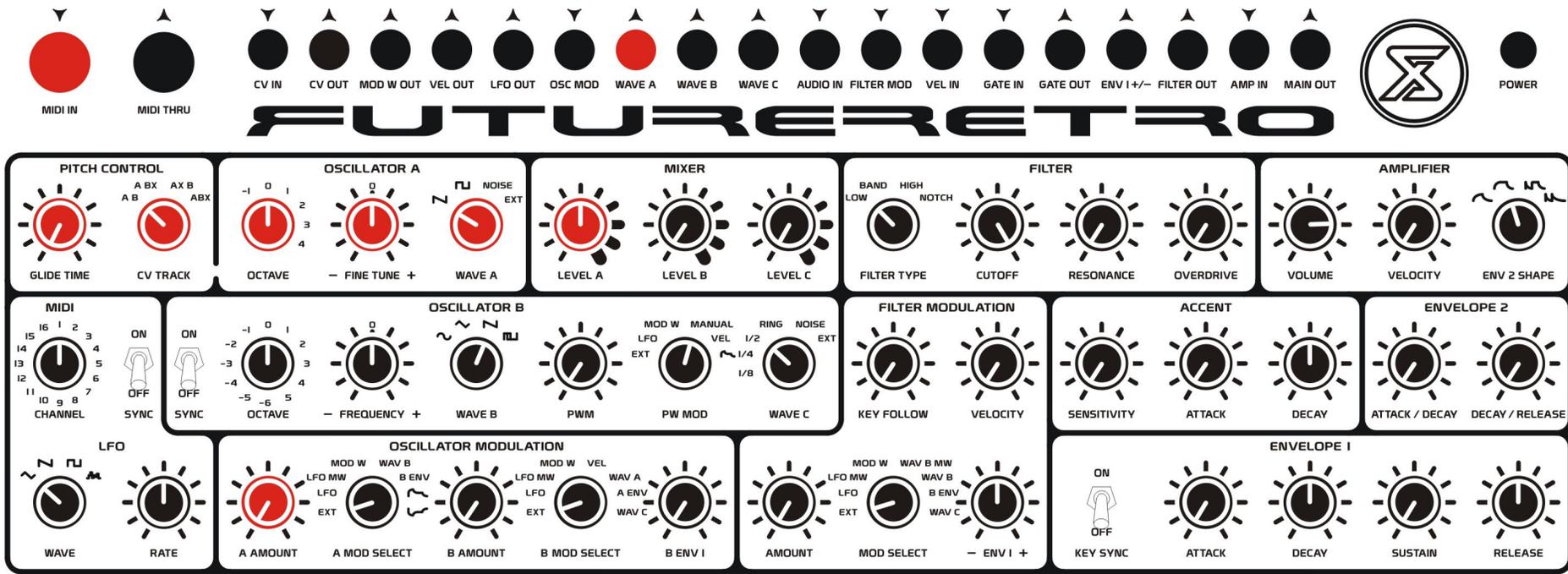
Octave control set to 2



Octave control set to 3



Octave control set to 4



**Step 4, Setting the Overall Pitch of Oscillator A:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the WAVE A output jack to a digital frequency counter (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated.

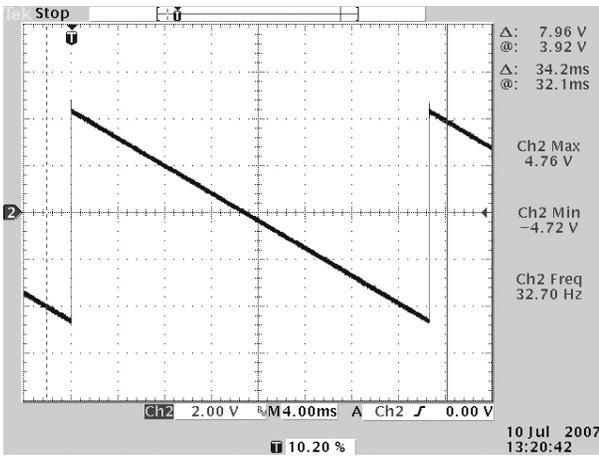
It is essential that you set Oscillator A's OCTAVE control to the "0" setting, and Oscillator A's FINE TUNE control is set to its mid position (indicated as "0"). Play note C1 on your MIDI keyboard and adjust trimmer TR4 until oscillator A's frequency is 32.703 hertz.

While calibrating this setting you can monitor the audio by connecting the Main Output of the XS to the input of your sound system if you wish to hear the adjustments you make.

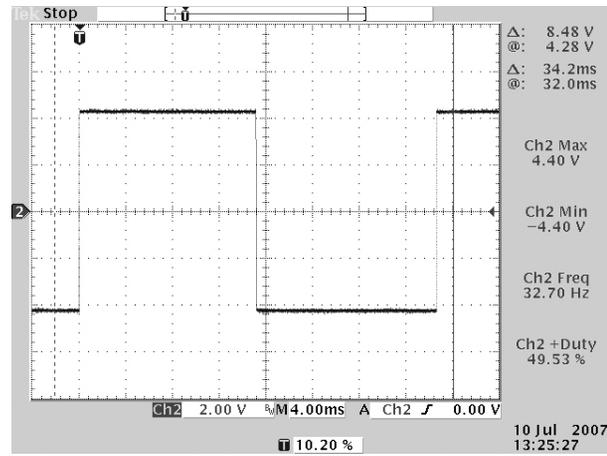
**Alternative Method:**

If you do not have access to a digital frequency counter, you could use a digital tuner to verify that the pitch is indeed in tune. Or you could audibly compare the pitch generated to that of another audio source which is known to be in tune. Although this method may not prove to be as accurate. When using this method it is better to try and match the highest playable frequency.

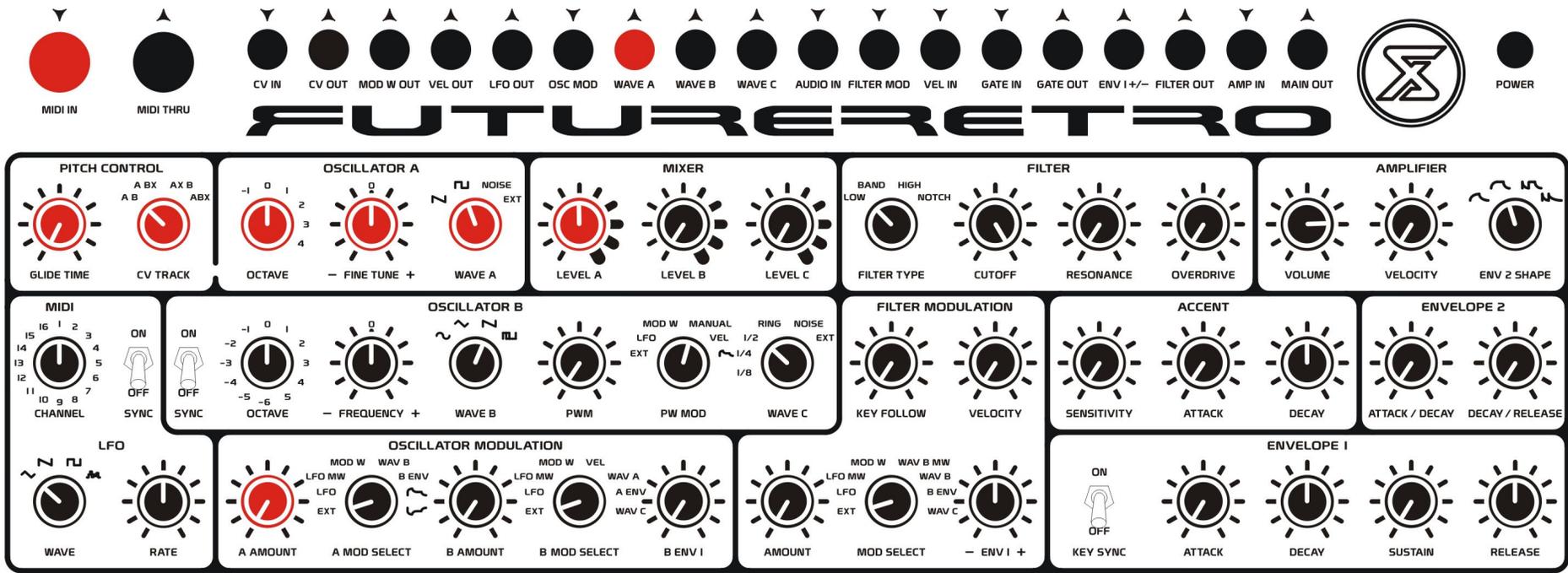
#### Step 4, Oscillator A Overall Pitch Calibration:



OR



Playing note C1 on MIDI keyboard, and Octave switch set for 0, tune oscillator to produce 32.703 Hz



**Step 5, Calibrating the Pulse Width Duration of Oscillator A’s Square Wave:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4” cable, connect the WAVE A output jack to an oscilloscope (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated.

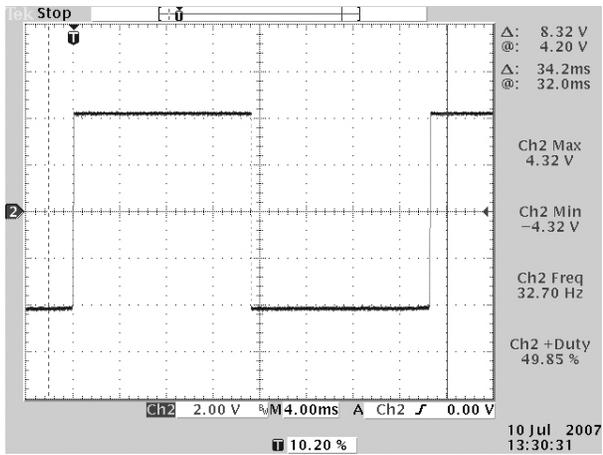
Set Oscillator A’s OCTAVE control to its “0” setting, and the WAVE A control to the Square wave shape. Play note C1 on your MIDI keyboard and adjust the oscilloscope to display 1 period of the waveform across the horizontal width of the display. Adjust trimmer TR5 until the both the high and low portions of this square wave are equal in their durations.

While calibrating this setting you can monitor the audio by connecting the Main Output of the XS to the input of your sound system if you wish to hear the adjustments you make.

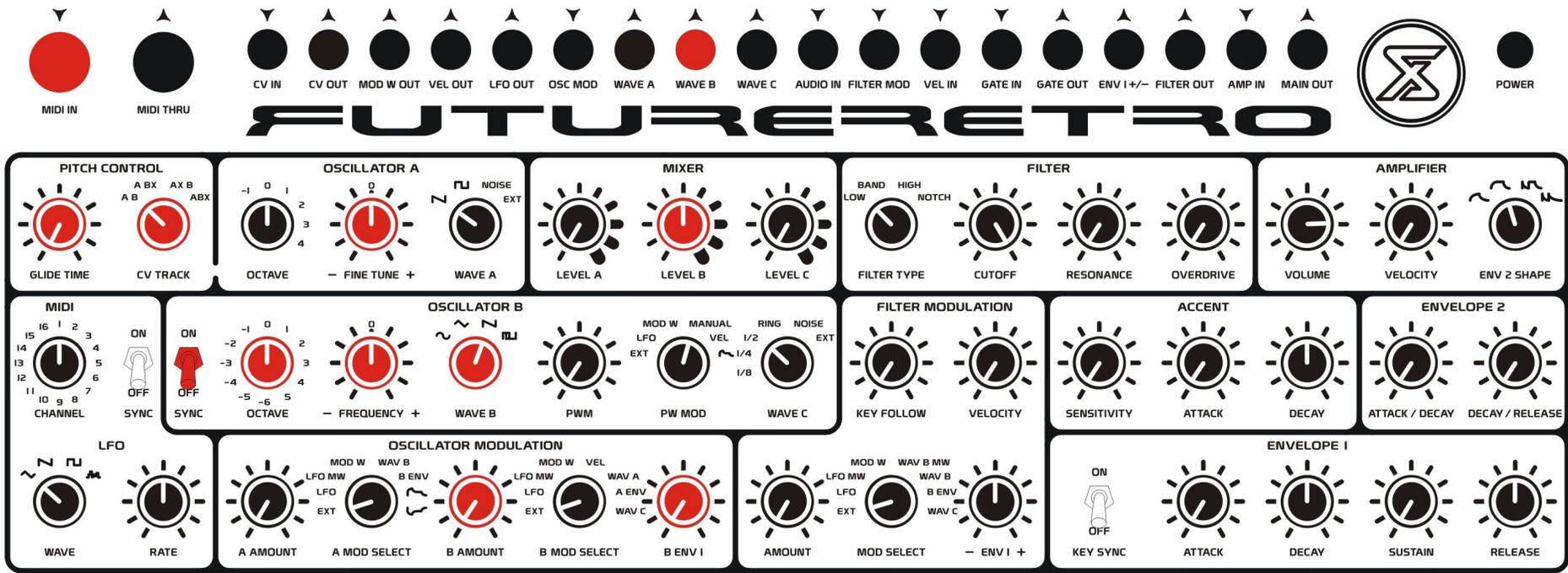
**Alternative Method:**

If you do not have access to an oscilloscope, listen to the Main Output of the XS while adjusting TR5 until the square wave produces a nice hollow sound.

### Step 5, Oscillator A Pulse Width Calibration:



Square wave with approximately a 50% duty cycle



### Step 6, Calibrating the Scale of Oscillator B:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the WAVE B output jack to an oscilloscope (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated.

Play note C1 on the MIDI keyboard, and adjust the oscilloscope to display 1 period of the waveform across the horizontal width of the display. Note where the waveform ends, as this will be our reference when tuning the other octaves. Play note C2 on the MIDI keyboard, and adjust trimmer TR6 until 2 periods of the waveform are displayed within the reference distance. Play note C3 on the MIDI keyboard, and adjust trimmer TR6 until 4 periods of the waveform are displayed within the reference distance. Play note C4 on the MIDI keyboard, and adjust trimmer TR6 until 8 periods of the waveform are displayed within the reference distance. Play note C5 on the MIDI keyboard, and adjust trimmer TR6 until 16 periods of the waveform are displayed within the reference distance. And finally, play note C6 on the MIDI keyboard, and adjust trimmer TR6 until 32 periods of the waveform are displayed within the reference distance.

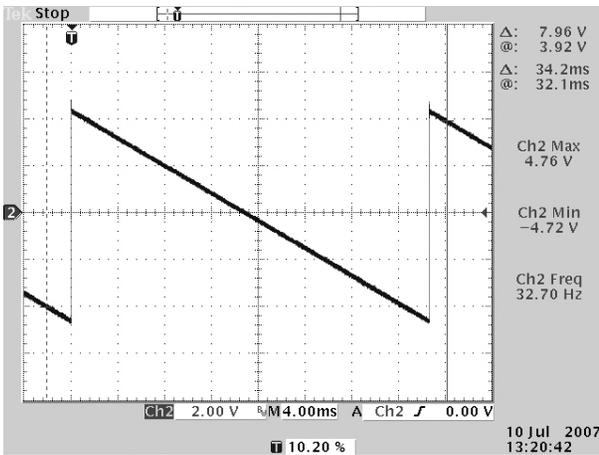
Now play notes C1, C2, C3, C4, C5 and C6 on the MIDI keyboard, while doing so make sure that ends of these waveforms are lining up perfectly with one another, at the defined reference distance.

While calibrating this control you can monitor the audio by connecting the Main Output of the XS to the input of your sound system if you wish to hear the adjustments you make.

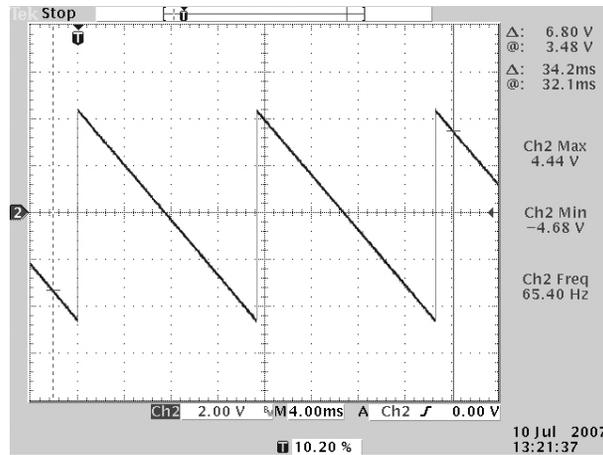
### Alternative Method:

If you do not have access to an oscilloscope, you could substitute the oscilloscope with a digital frequency counter. In this method you would connect the WAVE A output jack to the input of your frequency counter. And select the square waveform for WAVE A. Play note C1 and note the frequency generated. Play note C2 and adjust TR6 until the frequency is now twice that of note C1. Play note C3 and adjust TR6 until the frequency is four times that of note C1. Play note C4 and adjust TR6 until the frequency is 8 times that of note C1. Play note C5 and adjust TR6 until the frequency is 16 times that of note C1. And finally, play note C6 and adjust TR6 until the frequency is 32 times that of note C1.

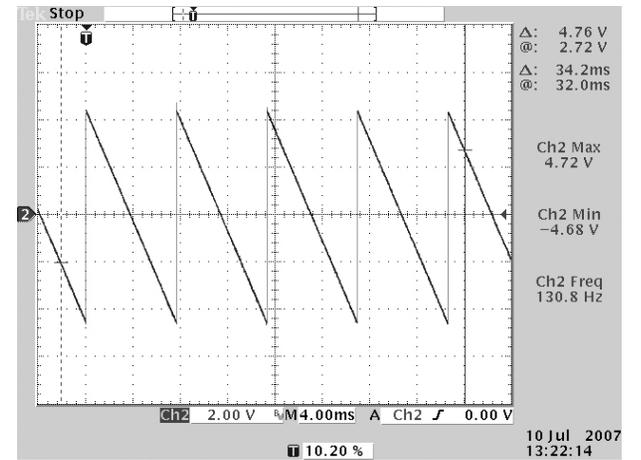
## Step 6, Oscillator B Scale Calibration:



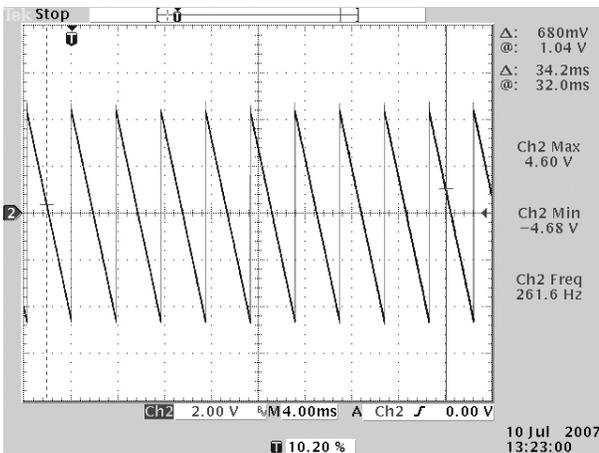
Playing C1 on MIDI keyboard



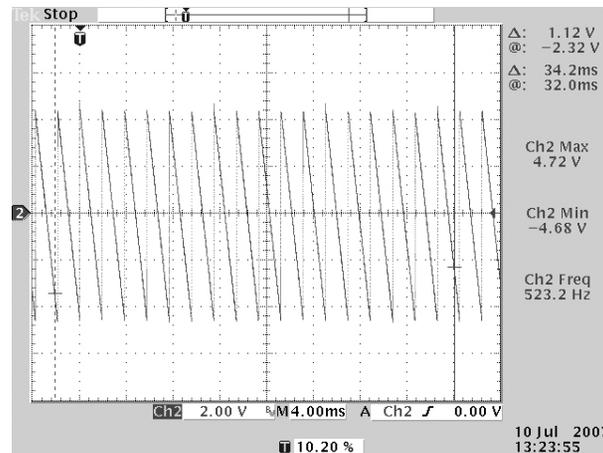
Playing C2 on MIDI keyboard



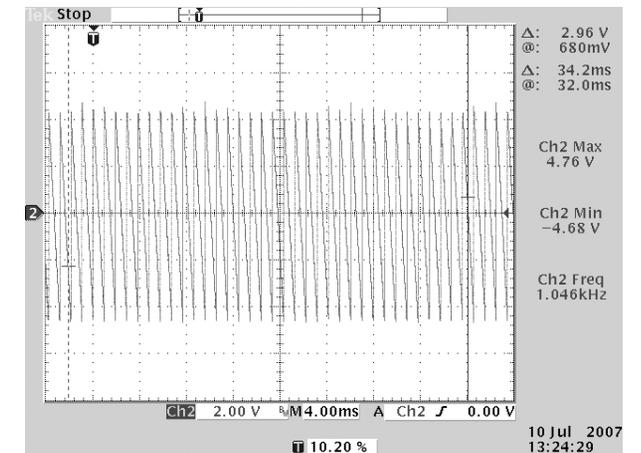
Playing C3 on MIDI keyboard



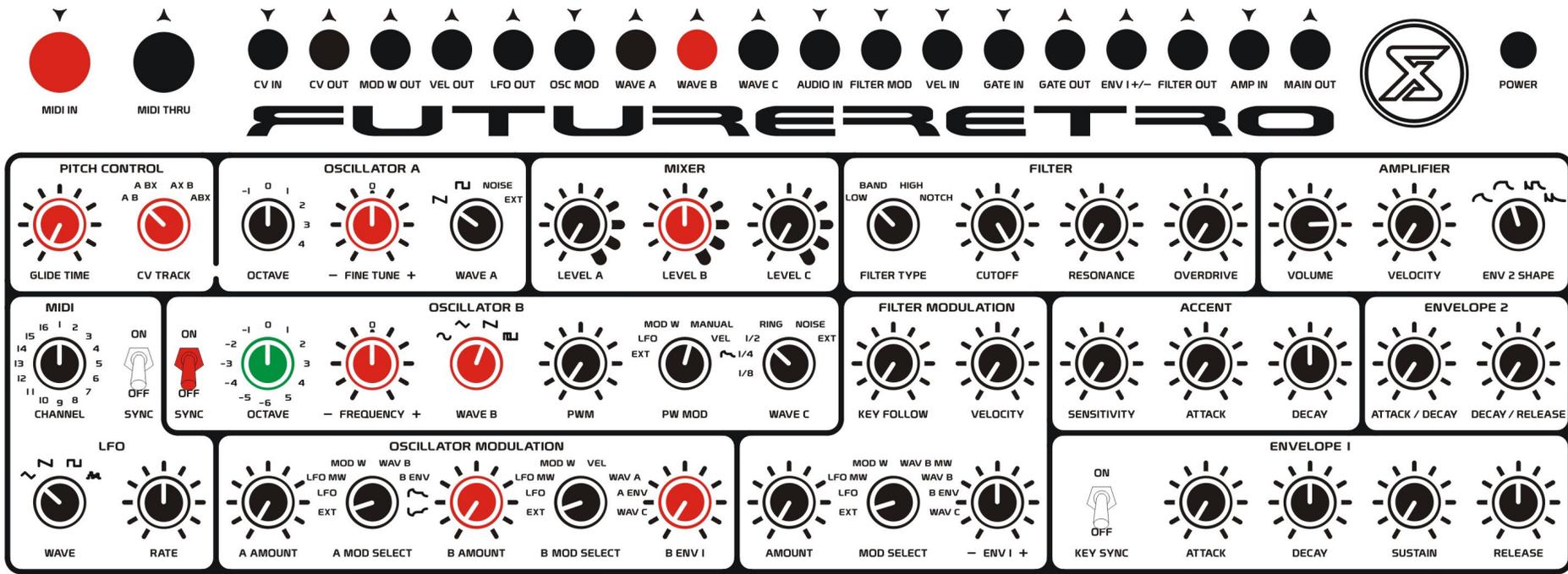
Playing C4 on MIDI keyboard



Playing C5 on MIDI keyboard



Playing C6 on MIDI keyboard



### Step 7, Calibrating the Octave Control of Oscillator B:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the WAVE B output jack to an oscilloscope (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated. The control shown in green is the one we will be adjusting. It may also be helpful to connect a digital tuner to the FILTER OUT jack to verify these octaves are in tune.

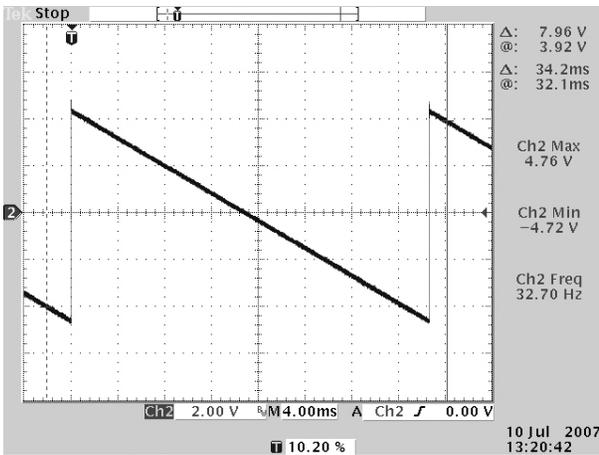
Play note C1 on the MIDI keyboard, and make sure the OCTAVE control for Oscillator B is set to its "0" setting. Adjust the oscilloscope to display 1 period of the waveform across the horizontal width of the display. Note where the waveform ends, as this will be our reference when calibrating the other octave divisions. Now select the OCTAVE "1" setting for this control and adjust trimmer TR7 so that 2 periods of the waveform are displayed within the reference distance. Select the OCTAVE "2" setting for this control and adjust TR7 so that 4 periods of the waveform are displayed within the reference distance. Select the OCTAVE "3" setting for this control and adjust TR7 so that 8 periods of the waveform are displayed within the reference distance. Select the OCTAVE "4" setting for this control and adjust TR7 so that 16 periods of the waveform are displayed within the reference distance. Select the OCTAVE "5" setting for this control and adjust TR7 so that 32 periods of the waveform are displayed within the reference distance. Now you can rotate the OCTAVE control quickly through settings 0 through 5, while doing so make sure that ends of these waveforms are lining up perfectly with one another, at the defined reference distance. If not, you may need to make slight adjustments to TR7 so that the waveforms are generating perfect octaves.

### Alternative Method:

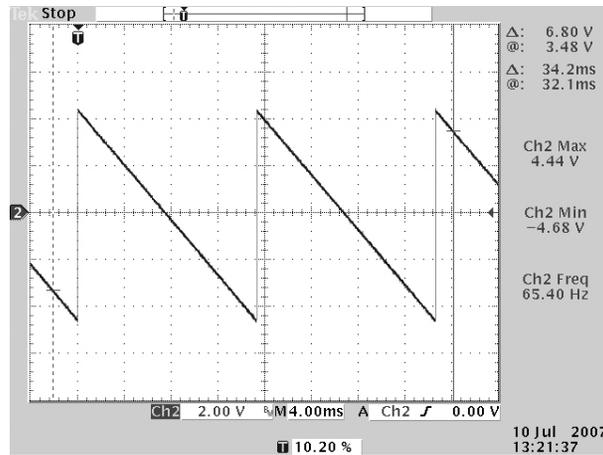
If you do not have access to an oscilloscope, you could substitute the oscilloscope with a digital frequency counter. In this method you would connect the WAVE A output jack to the input of your frequency counter. And select the square waveform for WAVE A. Play note C1, and set the OCTAVE control for Oscillator A to its "0" setting, and note the frequency being generated. Select the OCTAVE "1" setting and adjust TR7 until the frequency is 2 times the frequency produced by the "0" setting. Select the OCTAVE "2" setting and adjust TR7 until the frequency is 4 times the frequency produced by the "0" setting. Select the OCTAVE "3" setting and adjust TR7 until the frequency is 8 times the frequency produced by the "0" setting. Select the OCTAVE "4" setting and adjust TR7 until the frequency is 16 times the frequency produced by the "0" setting. Select the OCTAVE "5" setting and adjust TR7 until the frequency is 32 times the frequency produced by the "0" setting.

Note: You may need to redocument the frequency produced by the "0" OCTAVE for each new octave you calibrate, as the frequency of the "0" OCTAVE setting may change as TR7 is adjusted.

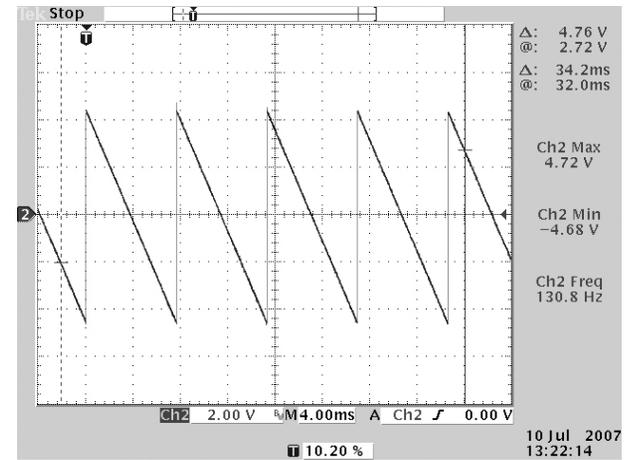
### Step 7, Oscillator B Octave Calibration:



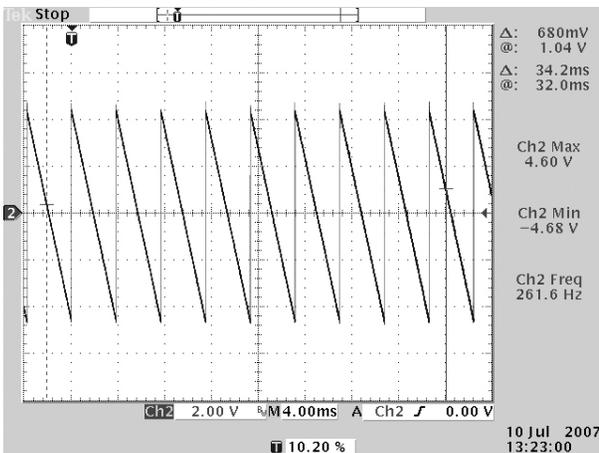
Octave control set to 0



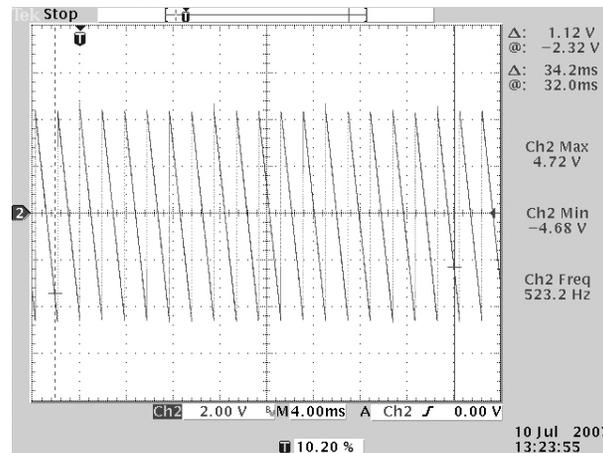
Octave control set to 1



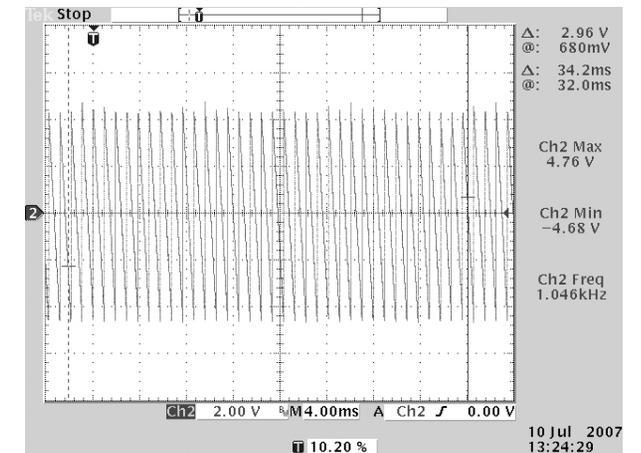
Octave control set to 2



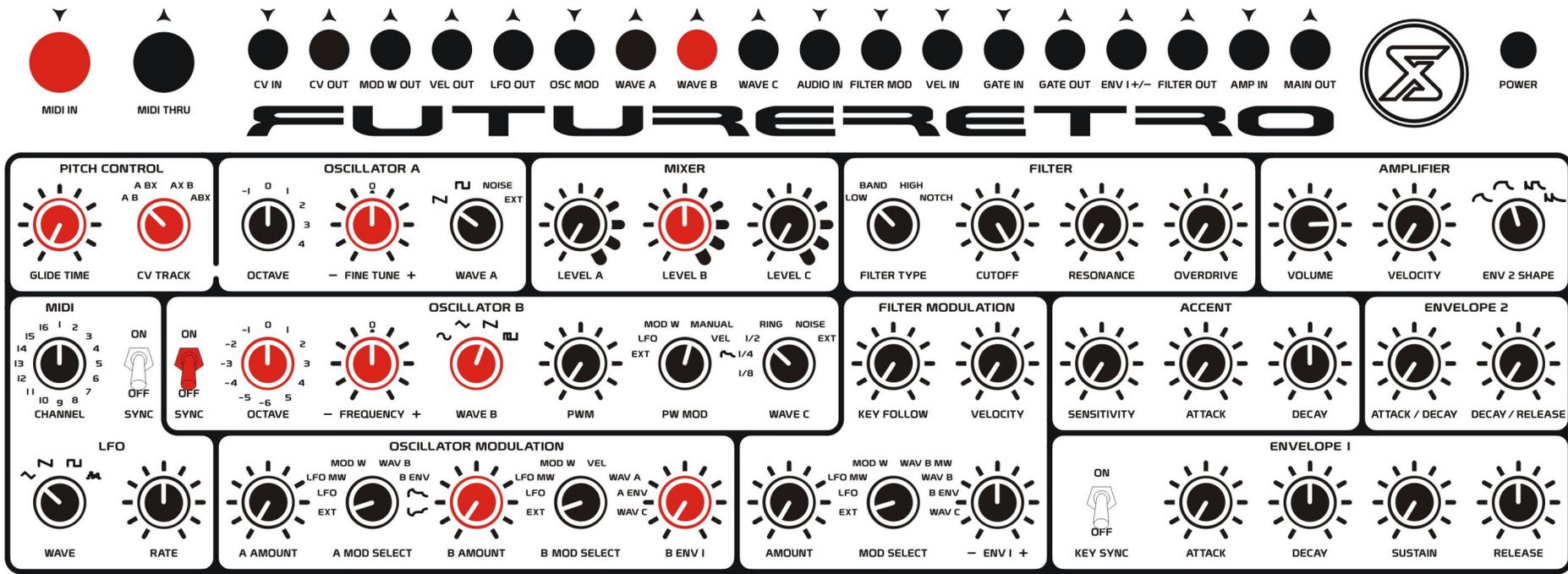
Octave control set to 3



Octave control set to 4



Octave control set to 5



**Step 8, Setting the Overall Pitch of Oscillator B:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the WAVE B output jack to a digital frequency counter (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated.

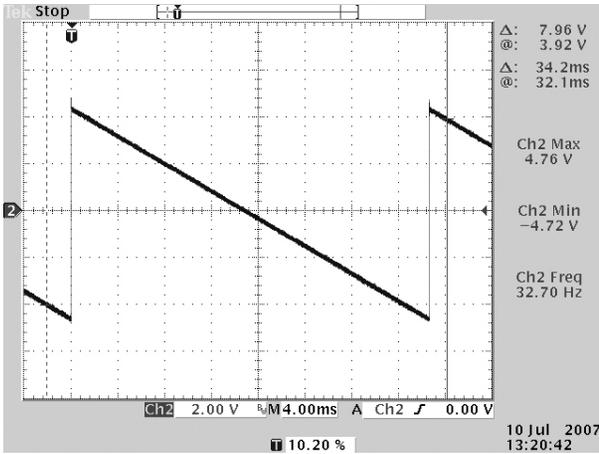
It is essential that you set Oscillator B's OCTAVE control to the "0" setting, Oscillator B's FREQUENCY control is set to its mid position (indicated as "0"), and Oscillator A's FINE TUNE control is set to its mid position (indicated as "0"). Play note C1 on your MIDI keyboard and adjust trimmer TR8 until oscillator B's frequency is 32.703 hertz.

While calibrating this setting you can monitor the audio by connecting the Main Output of the XS to the input of your sound system if you wish to hear the adjustments you make.

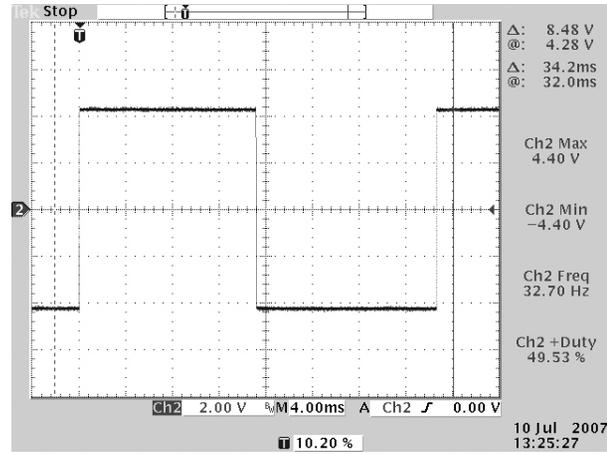
**Alternative Method:**

If you do not have access to a digital frequency counter, you could use a digital tuner to verify that the pitch is indeed in tune. Or you could audibly compare the pitch generated to that of Oscillator A or another audio source which is known to be in tune. Although this method may not prove to be as accurate. When using this method it is better to try and match the highest playable frequency which would be note C6.

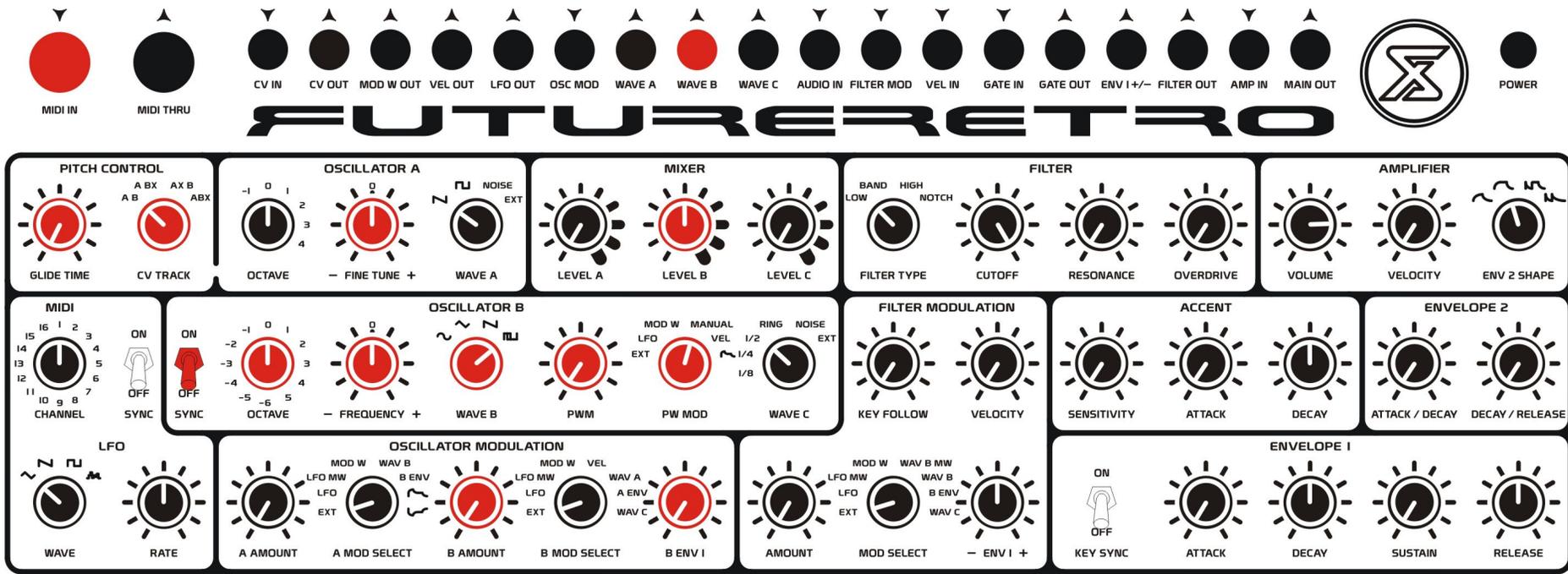
### Step 8, Oscillator B Overall Pitch Calibration:



OR



Playing note C1 on MIDI keyboard, and Octave switch set for 0, tune oscillator to produce 32.703 Hz



**Step 9, Calibrating the Pulse Width Duration of Oscillator B’s Square Wave:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4” cable, connect the WAVE B output jack to an oscilloscope (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated.

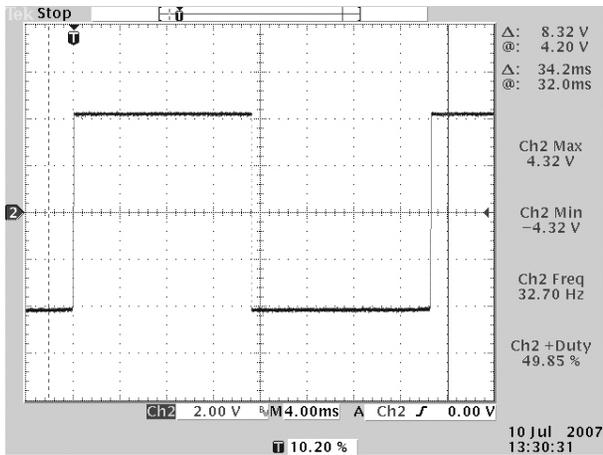
Play note C1 on your MIDI keyboard and adjust the oscilloscope to display 1 period of the waveform across the horizontal width of the display. Adjust trimmer TR9 until both the high and low portions of this square wave are equal in their durations.

While calibrating this setting you can monitor the audio by connecting the Main Output of the XS to the input of your sound system if you wish to hear the adjustments you make.

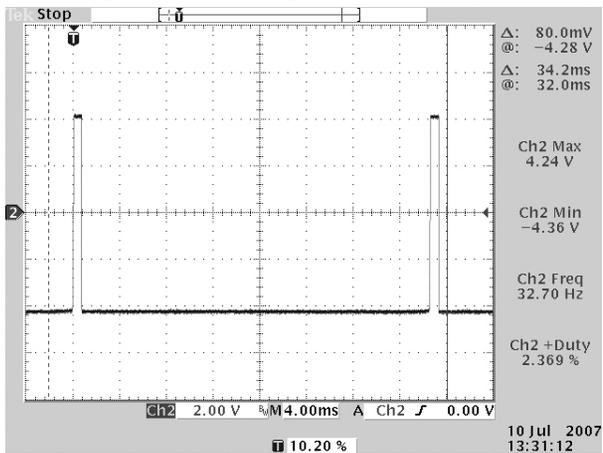
**Alternative Method:**

If you do not have access to an oscilloscope, listen to the Main Output of the XS while adjusting TR9 until the square wave produces a nice hollow sound. This method is not recommended however as it may lead to other errors when using features in the PW MOD section.

### Step 9, Oscillator B Pulse Width Calibration:

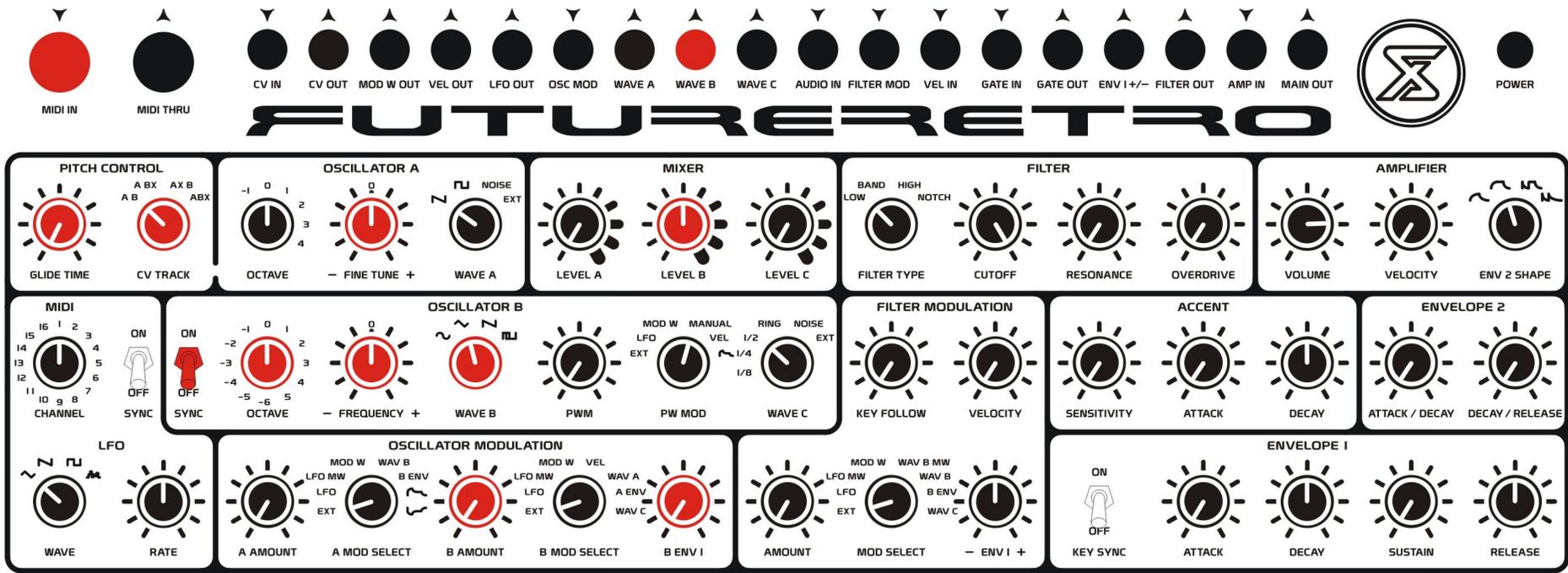


Square wave with approximately a 50% duty cycle



### TESTING THE PULSE WIDTH MODULATION FOR OSCILLATOR B

Using the same settings, set the PWM control fully clockwise, and the PW MOD control to the MANUAL setting. You should see the square wave create a pulse width similar to that shown here.



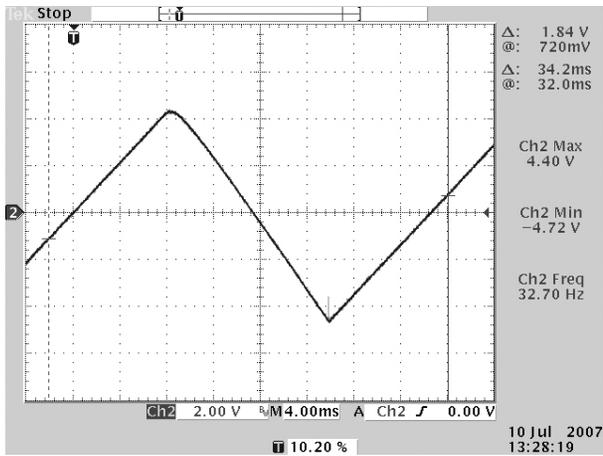
**Step 10, Calibrating Oscillator B's Triangle Wave Shape:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the WAVE B output jack to an oscilloscope (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated.

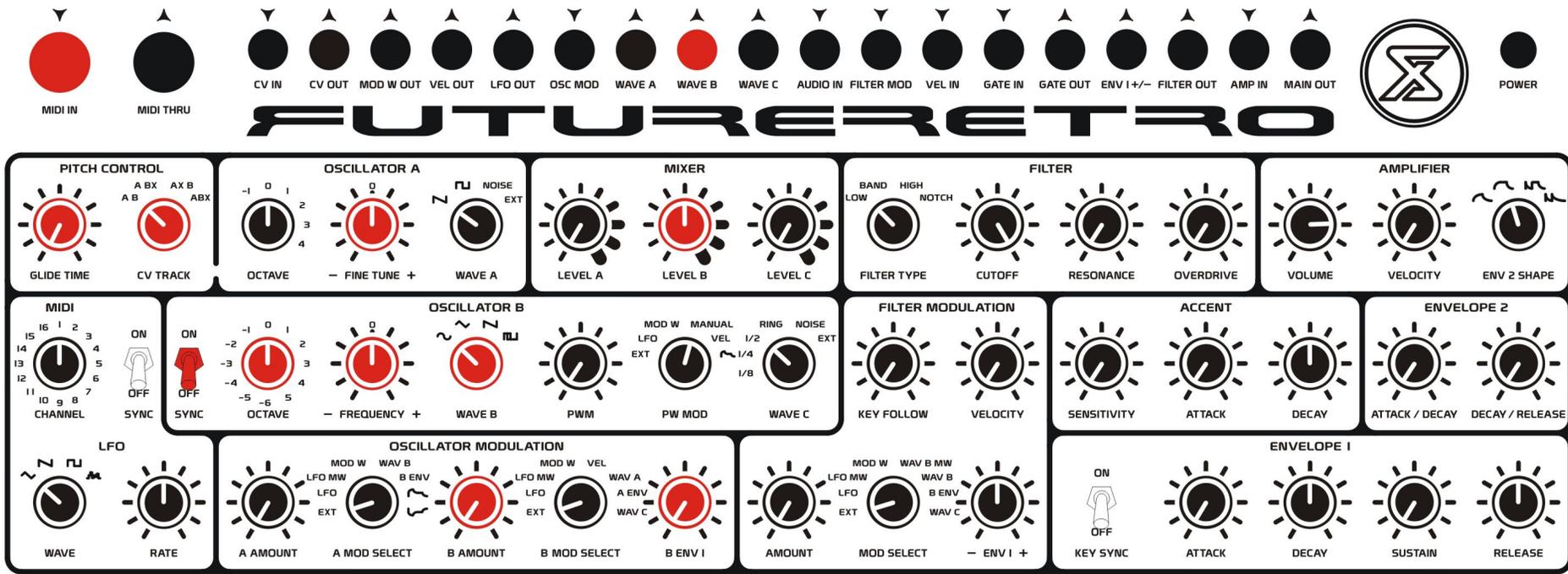
Play note C1 on your MIDI keyboard and adjust the oscilloscope to display 1 period of the waveform across the horizontal width of the display. Adjust trimmer TR10 until the Triangle waveform is vertically centered around ground. The adjust trimmer TR11 so the corners of the triangle wave form line up to produce a nice clean triangle waveform. Once again, readjust trimmer TR10 to vertically center the waveform around ground, and readjust TR11 until you have a nice clean triangle wave shape that is centered around ground.

While calibrating this setting you can monitor the audio by connecting the Main Output of the XS to the input of your sound system if you wish to hear the adjustments you make.

**Step 10, Oscillator B Triangle Wave Shape Calibration:**



Nice symmetrical triangle waveform



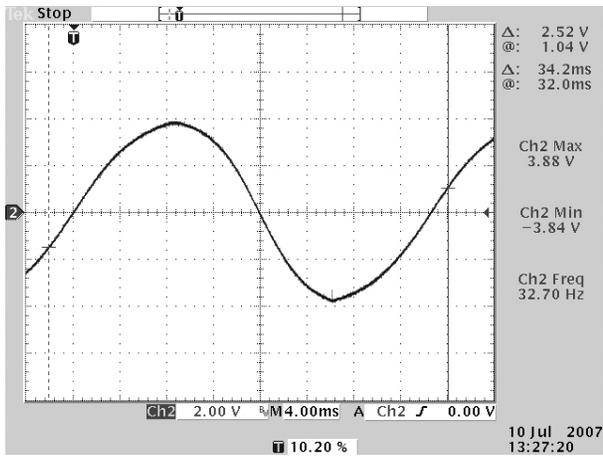
**Step 11, Calibrating Oscillator B's Sine Wave Shape:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the WAVE B output jack to an oscilloscope (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated.

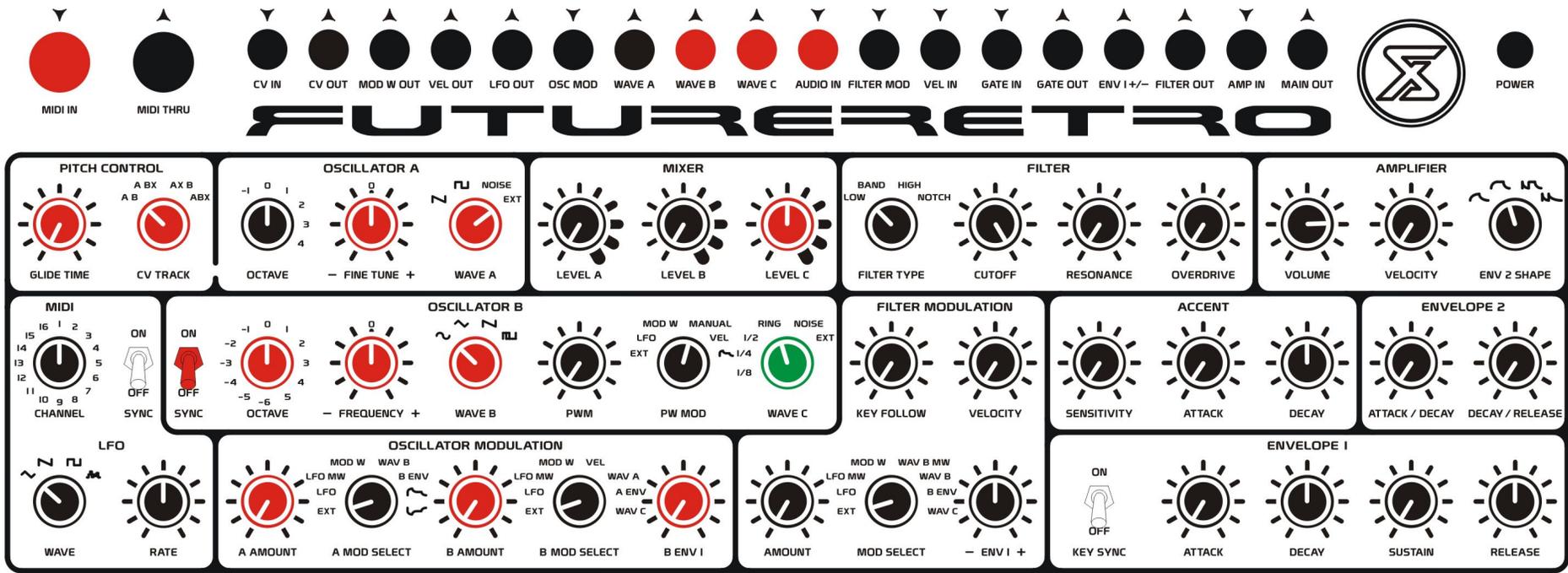
Play note C1 on your MIDI keyboard and adjust the oscilloscope to display 1 period of the waveform across the horizontal width of the display. Adjust trimmer TR12 so that the curvature of both the positive and negative portions of the sine wave look the same.

While calibrating this setting you can monitor the audio by connecting the Main Output of the XS to the input of your sound system if you wish to hear the adjustments you make.

**Step 11, Oscillator B Sine Wave Shape Calibration:**



Nice symmetrical sine waveform



### Step 12, Calibrating WAVE C's Ring Modulator:

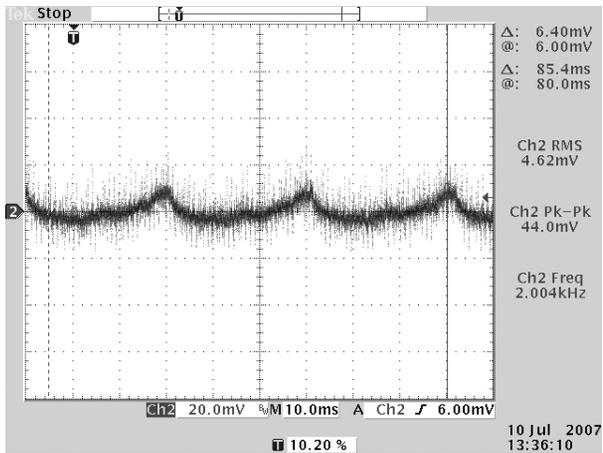
Using a 1/4" cable, connect the WAVE C output jack to an oscilloscope (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted during this procedure.

Set WAVE C's control to the "ring" setting. Adjust trimmer TR13 until the display shows the minimum amount of the sine wave signal on the oscilloscope. Note: you may need to increase the vertical sensitivity of your oscilloscope for best results.

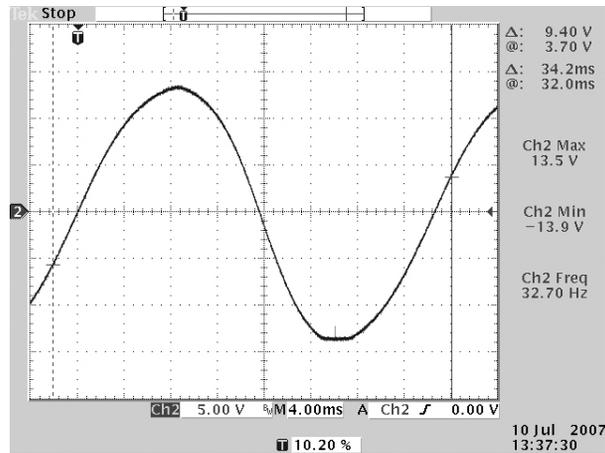
Next using another 1/4" cable, connect the WAVE B output jack to the AUDIO IN jack on the XS. Switch the WAVE C control to its "ext" setting and adjust the oscilloscope to display 1 period of the waveform across the horizontal width of the display. Now switch WAVE C's control back to the "ring" setting, and adjust trimmer TR14 so the sine wave produced now has minimum skewing or distortion, and is displaying 2 periods of the waveform in the horizontal width of the display.

While calibrating this setting you can monitor the audio by connecting the Main Output of the XS to the input of your sound system if you wish to hear the adjustments you make.

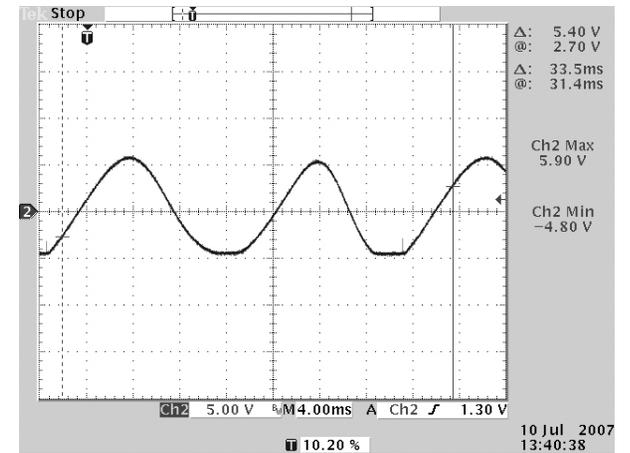
### Step 12, WAVE C Ring Modulator Calibration:



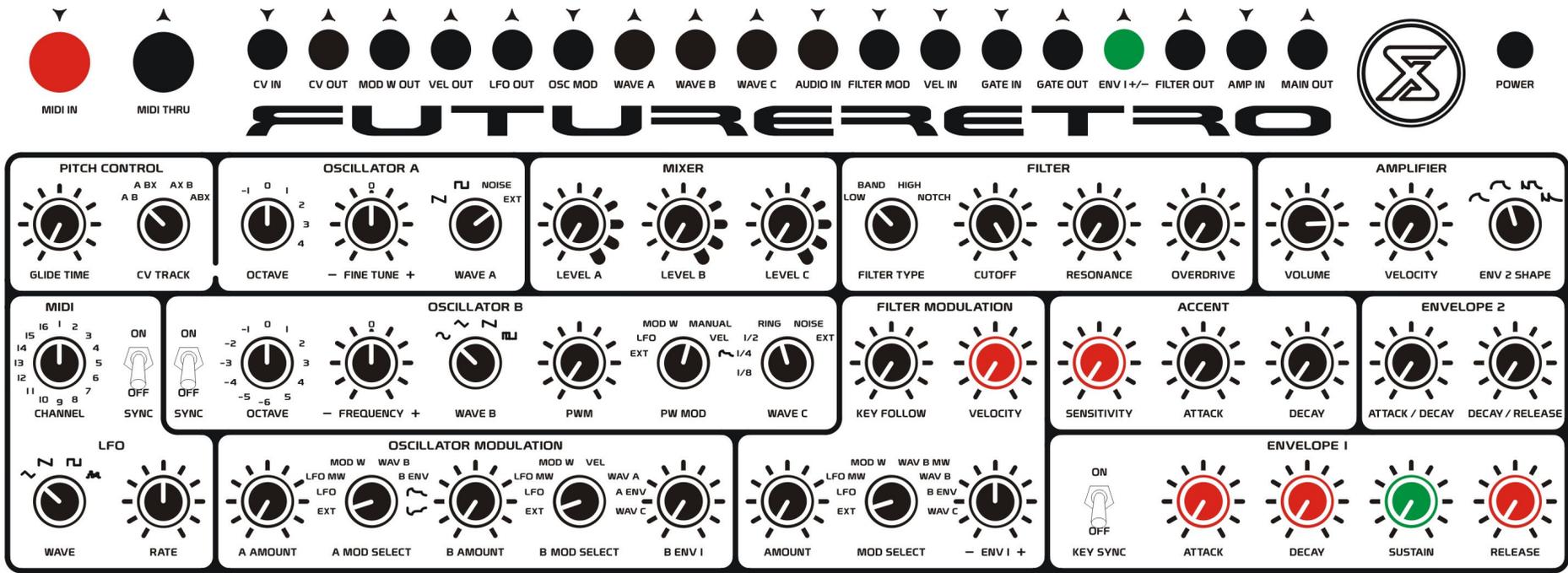
First adjust for minimum amount of signal with TR13



WAVE C when set to EXT, and WAVE B is connected to the AUDIO IN jack



Sine wave doubling in frequency when WAVE C is in the RING setting



### Step 13, Calibrating Envelope 1:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, fully insert one end into the ENV1 +/- output jack and connect the other end to an oscilloscope (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted during this procedure.

Play and hold a note on the MIDI keyboard, as you adjust the your oscilloscope settings so the lowest portion of the envelope lines up with the vertical center of your oscilloscope screen (which should be the oscilloscopes ground reference).

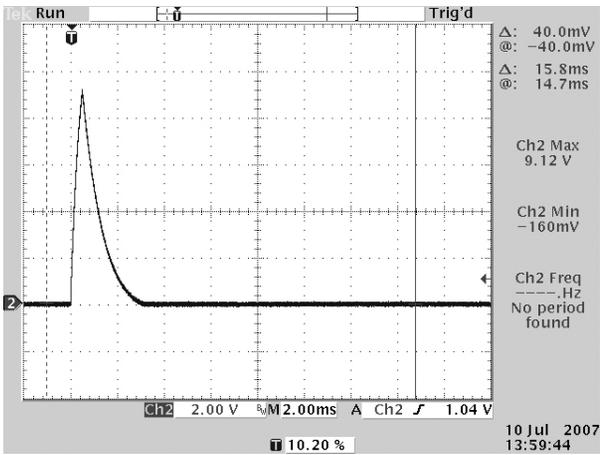
Now rotate the SUSTAIN control in Envelope 1 fully clockwise. Pull the 1/4" cable out which is fully inserted into the ENV1 +/- jack, and reinsert the cable so it is just making contact with the first connection, but does not click into place. (Note: If the cable clicks into first position of the jack, your oscilloscope reading will be wrong as both the positive and negative portions of the envelope will be summed together.)

Again play and hold a note on the MIDI keyboard and adjust trimmer TR15 until the scope trace is at the vertical center of your oscilloscope screen (which should be the oscilloscopes ground reference).

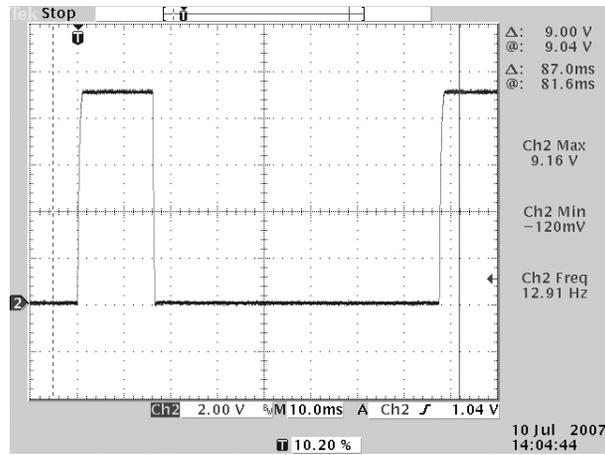
### Alternative Method:

If you do not have access to an oscilloscope, set Oscillator A's OCTAVE control to "0", FINE TUNE control to "0", and WAVE A control to the Square wave shape. Set LEVEL A in the mixer section to its mid position, and rotate LEVEL B and LEVEL C controls fully counter clockwise. In the Oscillator Modulation Section set the A AMOUNT control fully clockwise, and select the positive polarity envelope setting for the A MOD SELECT control. Set the SUSTAIN control for Envelope 1 fully counter clockwise and play a note on your MIDI keyboard. Listen to the pitch that is generated by Oscillator A. Then switch the A MOD SELECT control in the Oscillator modulation section to the negative polarity envelope, and set the SUSTAIN control for Envelope 1 fully clockwise. Play the same note as before, as you adjust TR15 so both settings produce the same pitch for Oscillator A.

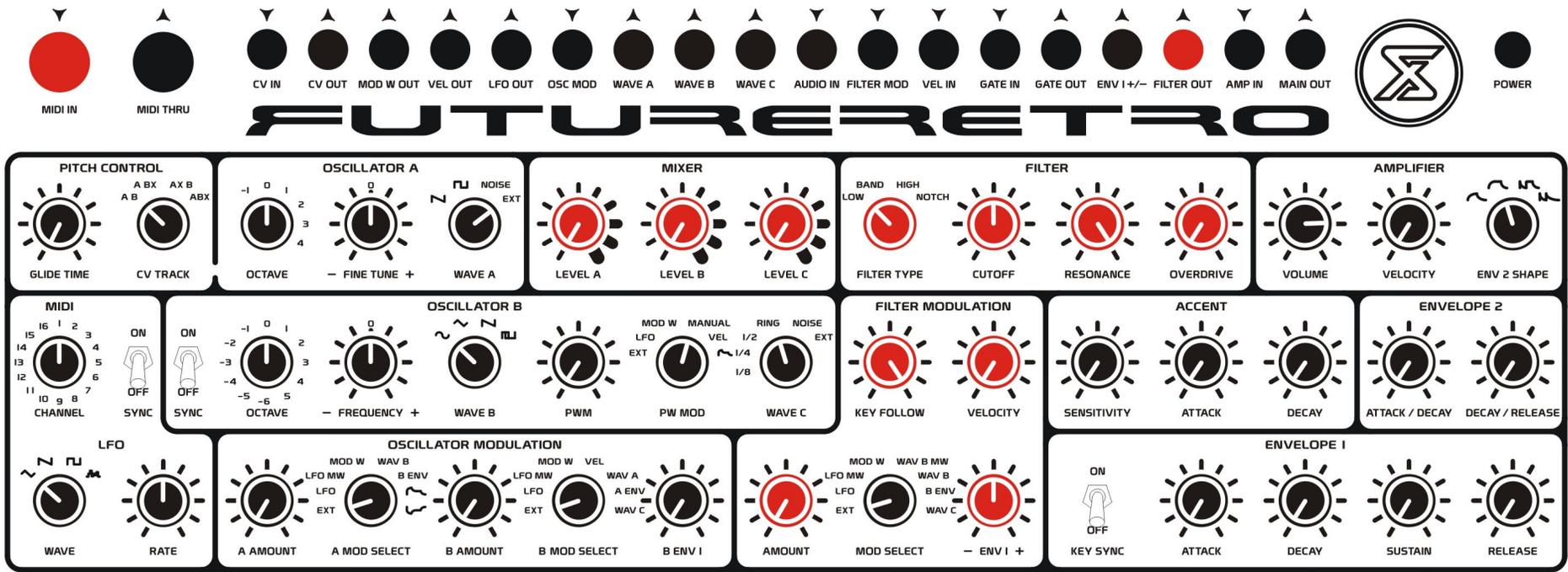
### Step 13, Envelope 1 Calibration:



Note the lowest portion of the positive polarity  
And set this as your reference



When looking at the negative polarity envelope make  
sure it's lowest portion lines up with your reference



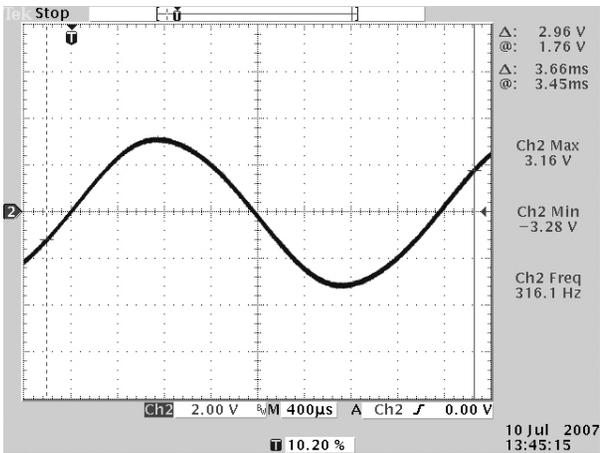
**Step 14, Calibrating the Filter Pitch Tracking:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the FILTER OUT output jack to an oscilloscope (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated.

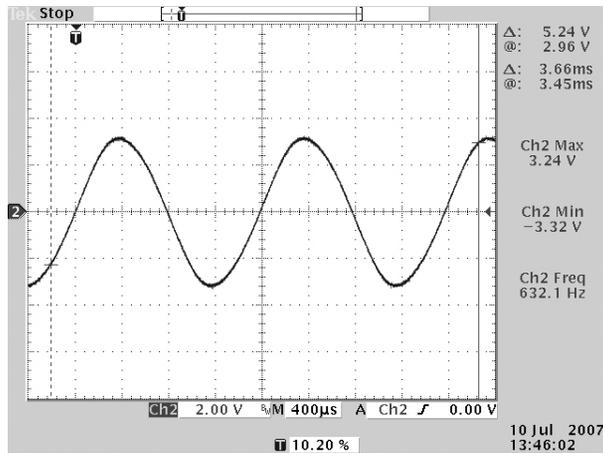
Note: When the Filter's RESONANCE control is turned fully clockwise, the filter should then be self oscillating creating a sine wave.

Play note C1 on the MIDI keyboard, and adjust the oscilloscope to display 1 period of the waveform across the horizontal width of the display. Note where the waveform ends, as this will be our reference when tuning the other octaves. In general, it is best to have the sine wave signal centered around the ground reference of the oscilloscope with the oscilloscope syncing to the ground portion of the sine wave. Play note C2 on the MIDI keyboard, and adjust trimmer TR16 until 2 periods of the sine wave are displayed within the reference distance. Play note C3 on the MIDI keyboard, and adjust trimmer TR16 until 4 periods of the sine wave are displayed within the reference distance. Now you can toggle back and forth between playing notes C1 and C3 on the MIDI keyboard, while doing so make sure that ends of the waveform are lining up perfectly with one another, at the defined reference distance.

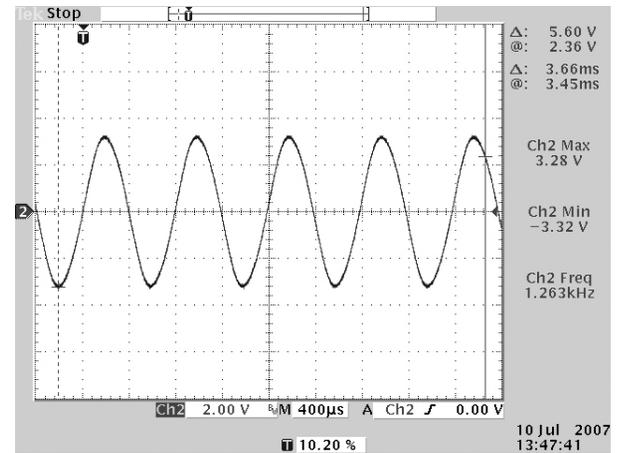
### Step 14, Filter Pitch Tracking Calibration:



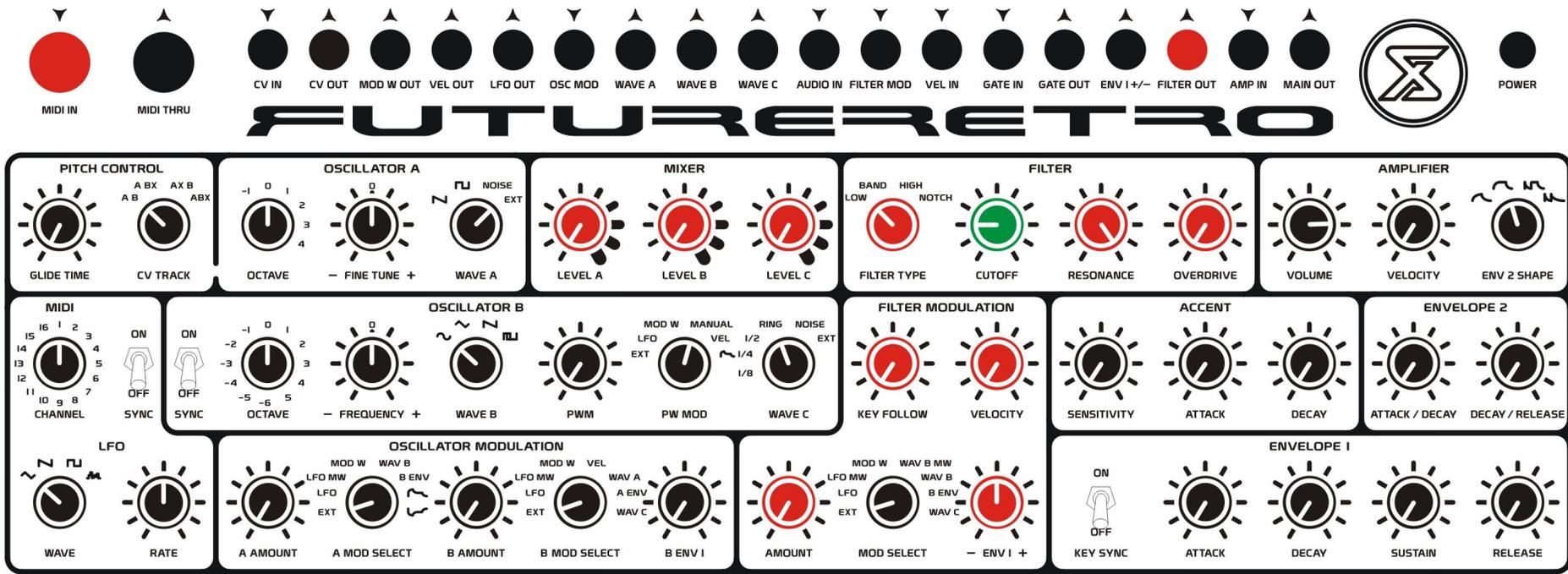
Playing note C1 on MIDI keyboard



Playing note C2 on MIDI keyboard



Playing note C3 on MIDI keyboard



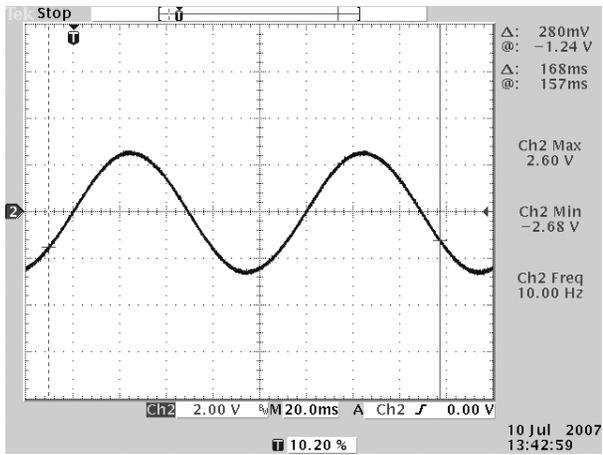
### Step 15, Calibrating the Filter Cutoff Range:

Using a 1/4" cable, connect the FILTER OUT output jack to an oscilloscope (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

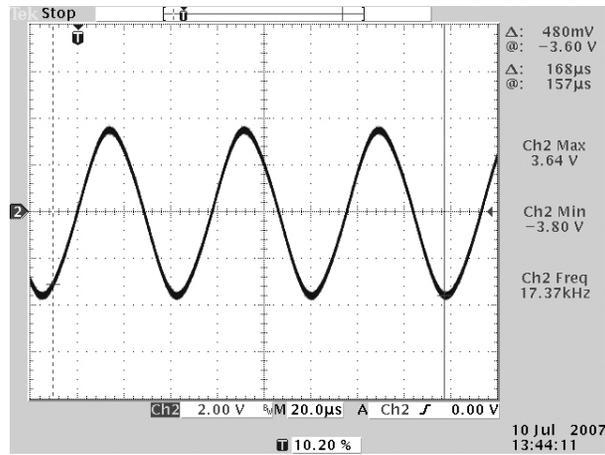
Set the CUTOFF control in the Filter section to the 9 O'clock position. Adjust trimmer TR17 so the sine wave generated at the FILTER OUT jack has a frequency of 10 hertz. Note: 10 hertz is equal to .1 seconds, or 100 milliseconds.

Now rotate the CUTOFF control in the Filter section fully clockwise and verify that the highest frequency is approximately 18,000 hertz, or 18 kHz. You may wish to adjust TR17 to get the highest frequency closer to 18 kHz, although at some point you will notice the trimmer no longer has any effect in increasing this frequency. At that point you should stop adjusting TR17 to allow the CUTOFF control to cover the maximum range of frequencies.

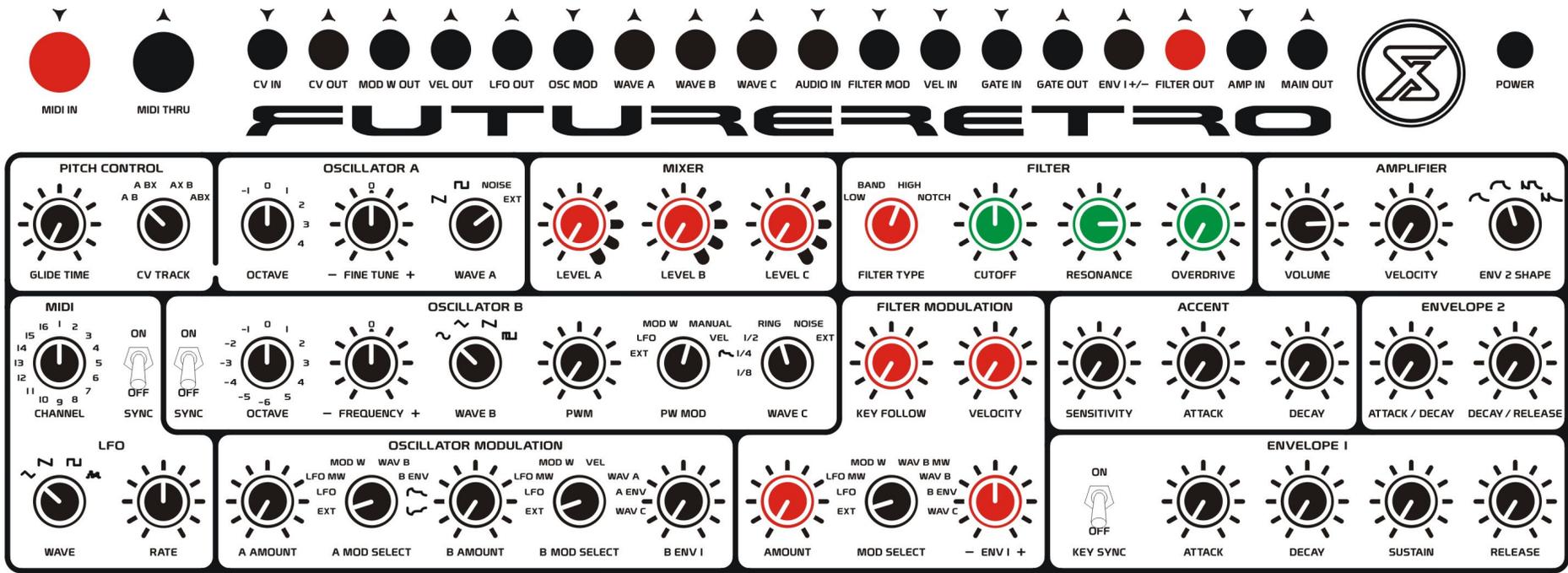
### Step 15, Filter Cutoff Range Calibration:



Cutoff frequency at the 9 O'clock position



Cutoff frequency turned fully clockwise



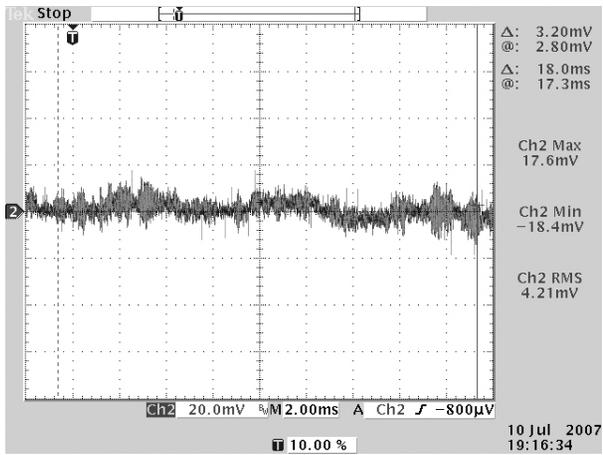
### Step 16, Calibrating the Overdrive Noise Gate:

Using a 1/4" cable, connect the FILTER OUT output jack to an oscilloscope (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

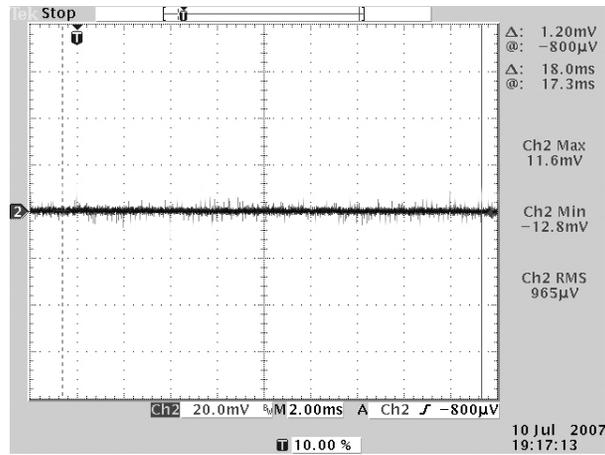
Set the CUTOFF control in the Filter section to its mid position. Set the OVERDRIVE control in the Filter section fully counter clockwise. Slowly increase the RESONANCE setting until a sine wave can be seen on the oscilloscope, and then while rotating the CUTOFF control back and forth through its entire range, adjust the RESONANCE control just slightly counter clockwise so the filter no longer self oscillates.

Now set the OVERDRIVE control in the Filter section fully clockwise and sweep the CUTOFF control through its entire range as you adjust trimmer TR18 so that no waveform spikes can be seen on the oscilloscope.

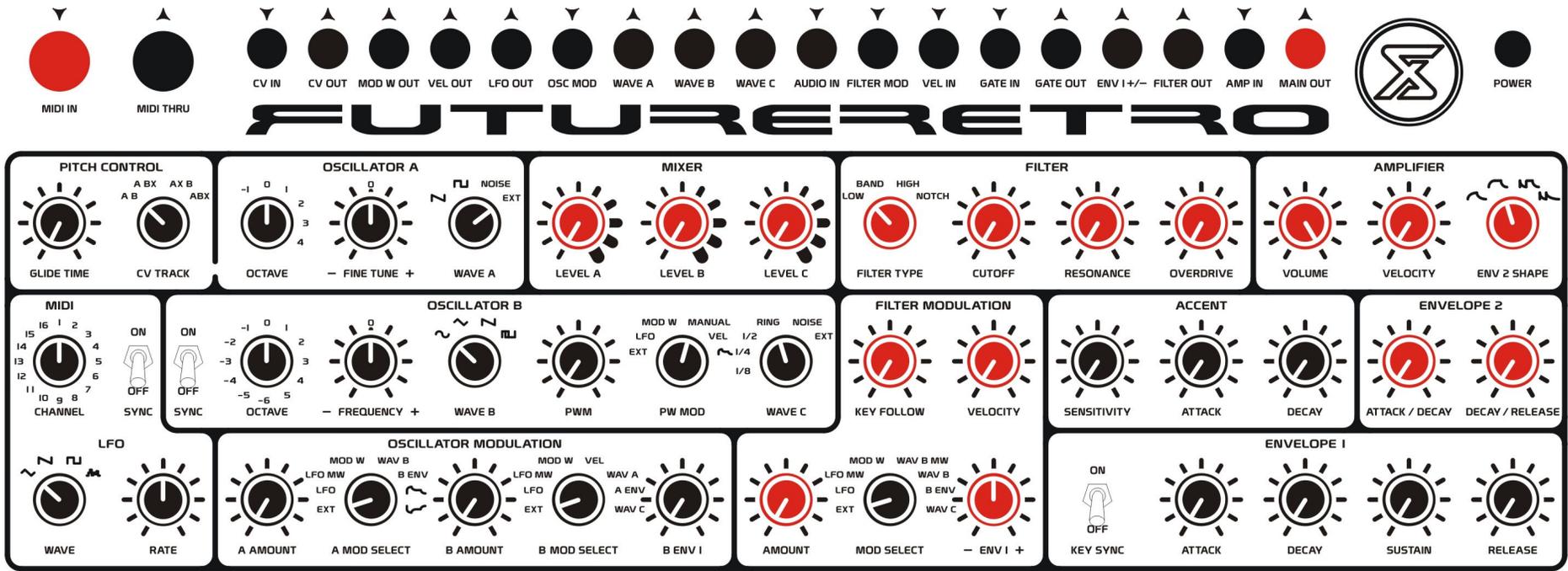
### Step 16, Overdrive Noise Gate Calibration:



Filter output set just below self resonance



Overdrive control set fully clockwise and trimmed



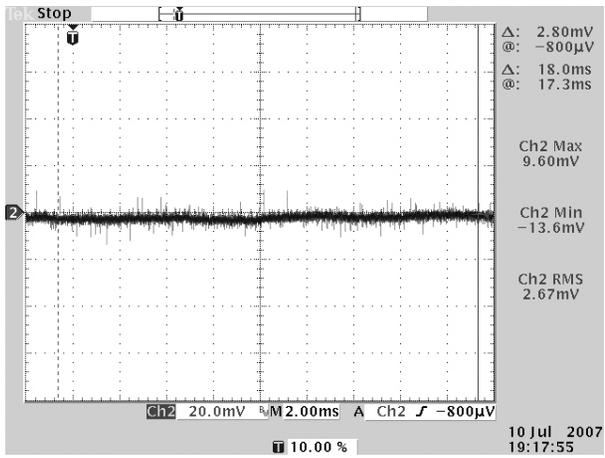
**Step 17, Calibrating the Amplifier:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the MAIN OUT output jack to an oscilloscope (probe will connect to the tip, ground terminal will connect to the shield of the connector). Controls shown in red must be set to the settings as indicated.

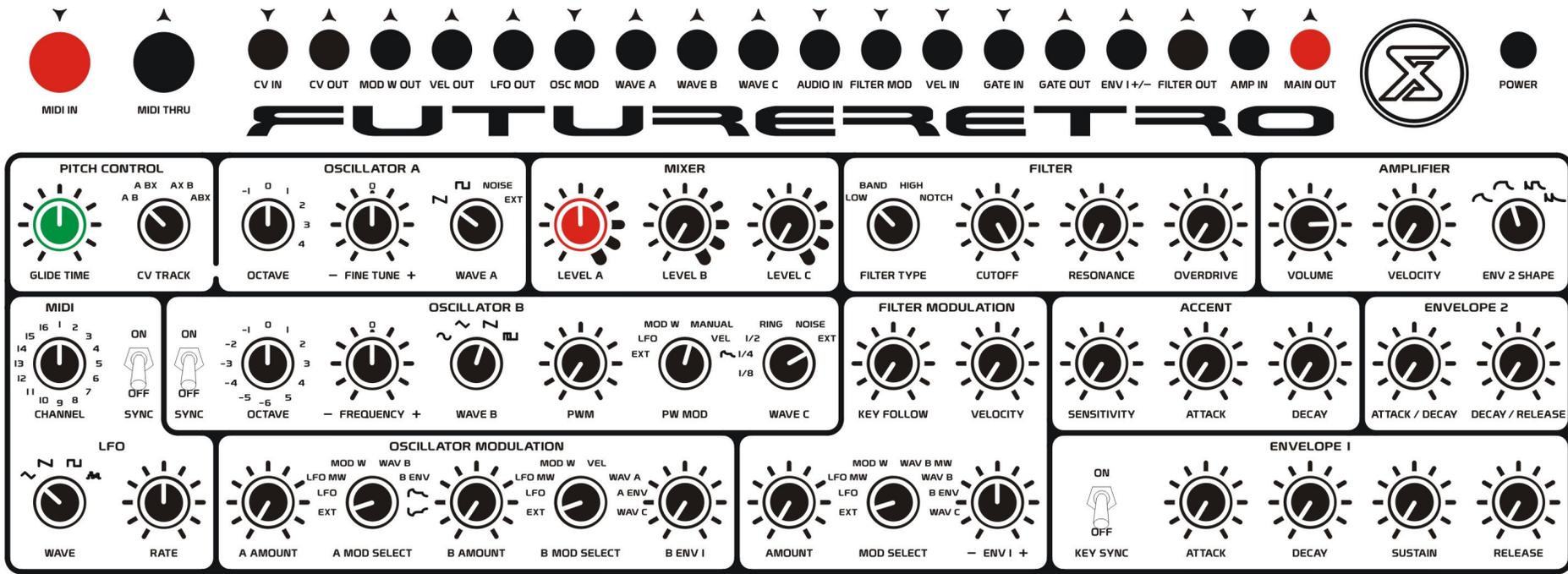
For this procedure you will want to set the vertical resolution of your oscilloscope to a setting of 20mV, or something similar.

Play a note repeatedly on your MIDI keyboard as you adjust trimmer TR19 to eliminate all transient pulses that can be seen on the oscilloscope, and so the scope trace is at ground level.

### Step 17, Amplifier Calibration:



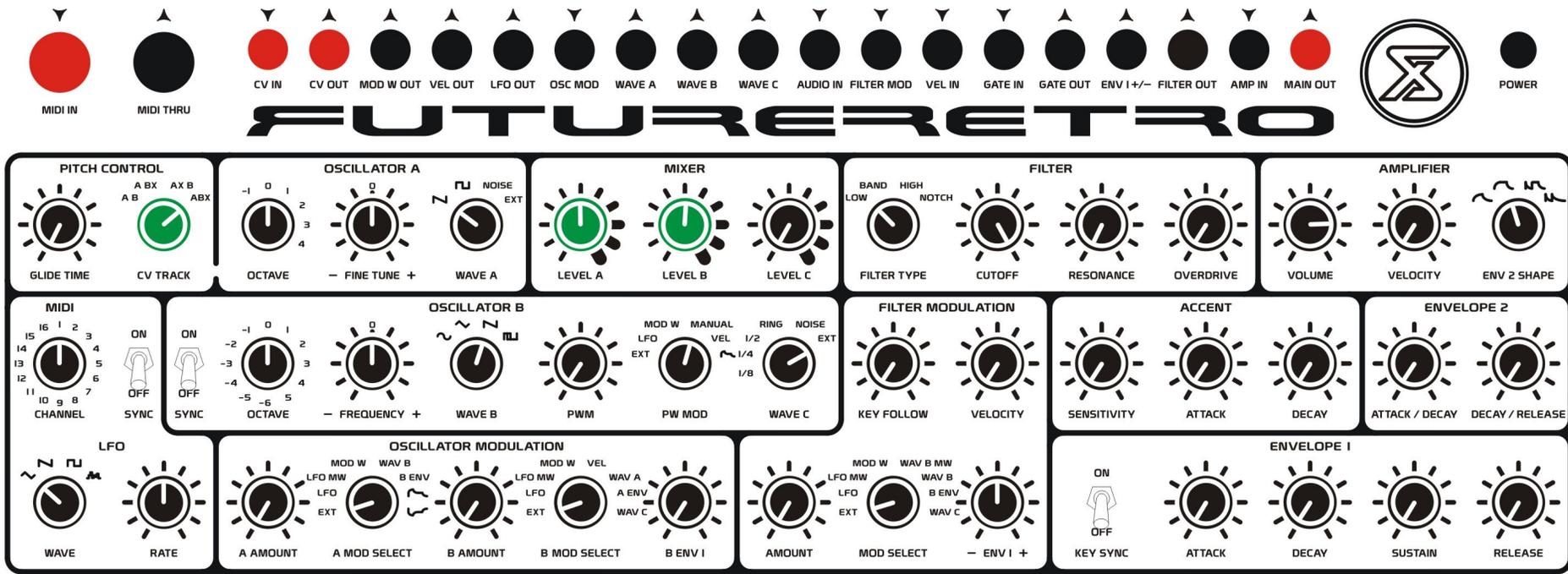
Main output adjusted for minimum transient pulses



**Step 18, Testing the Glide Time:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the MAIN OUT output jack to your audio system. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

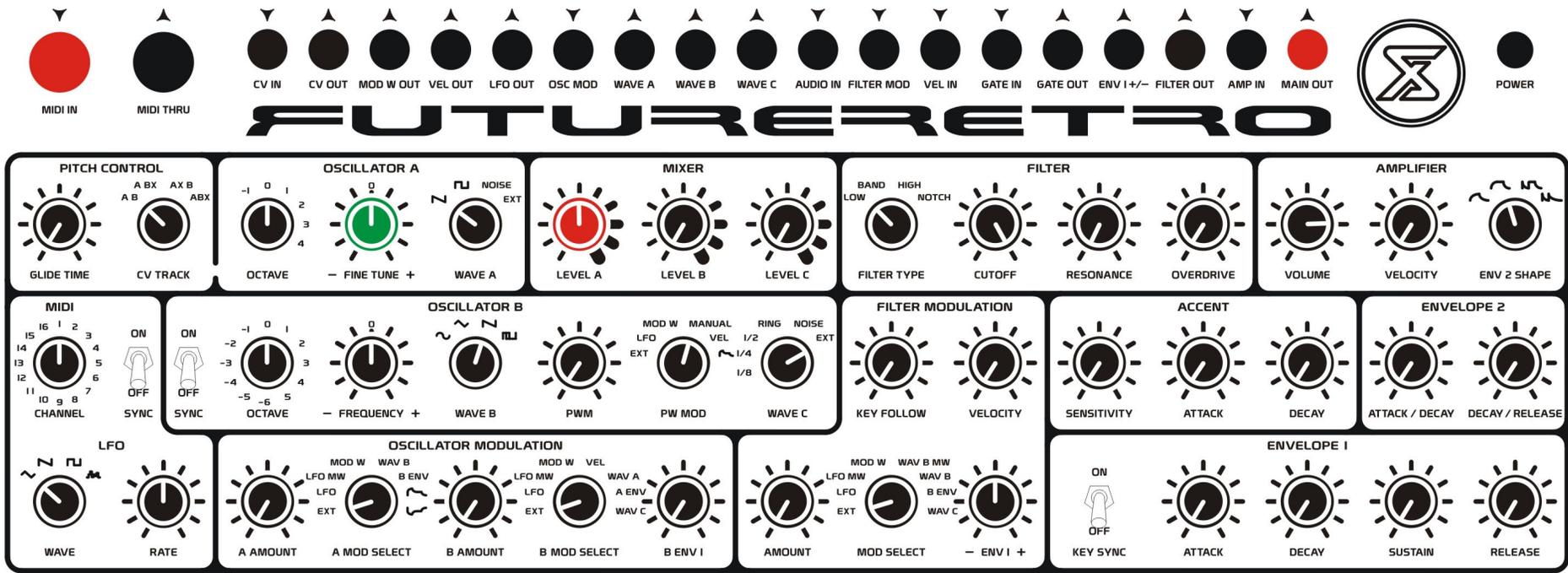
Play and hold note C1 on your MIDI keyboard, while doing so, play and release note C2 on your MIDI keyboard. You should hear the pitch of the oscillator smoothly transitioning from one pitch to the other at the rate set by the Glide Time control. When this control is turned fully counter clockwise, the oscillator should abruptly jump from one pitch to the other. As this control is rotated farther clockwise, the time it takes to go from one pitch to the other will increase.



**Step 19, Testing the CV IN:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the MAIN OUT output jack to your audio system. Using another 1/4" cable connect the CV IN jack to the CV OUT jack. Controls shown in green will need to be adjusted for this procedure.

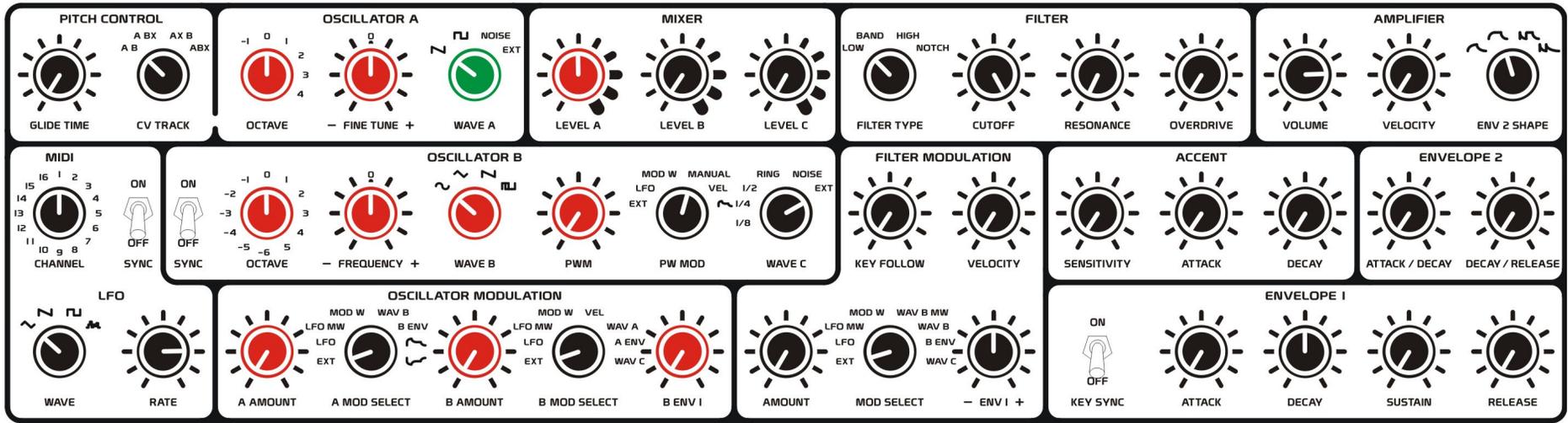
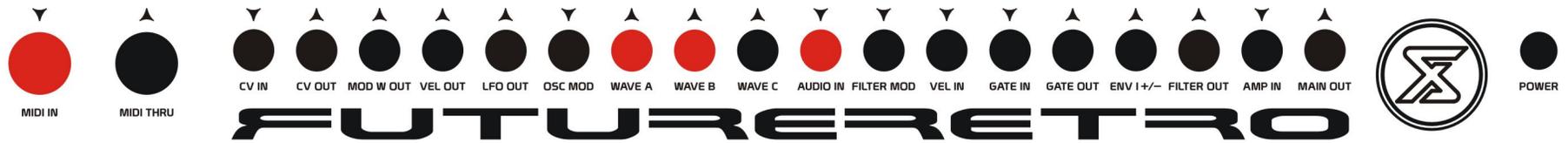
Start with the CV TRACK control in the A B position and play notes C1, C2, and C3 on your MIDI keyboard. Notice the pitch the oscillators are generating. Now rotate the CV TRACK control to the ABX setting, and play notes C1, C2, and C3 on your MIDI keyboard. You should hear the same pitches being played in the ABX setting as were in the A B setting.



**Step 20, Testing Oscillator A's Fine Tune Control:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the MAIN OUT output jack to your audio system. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

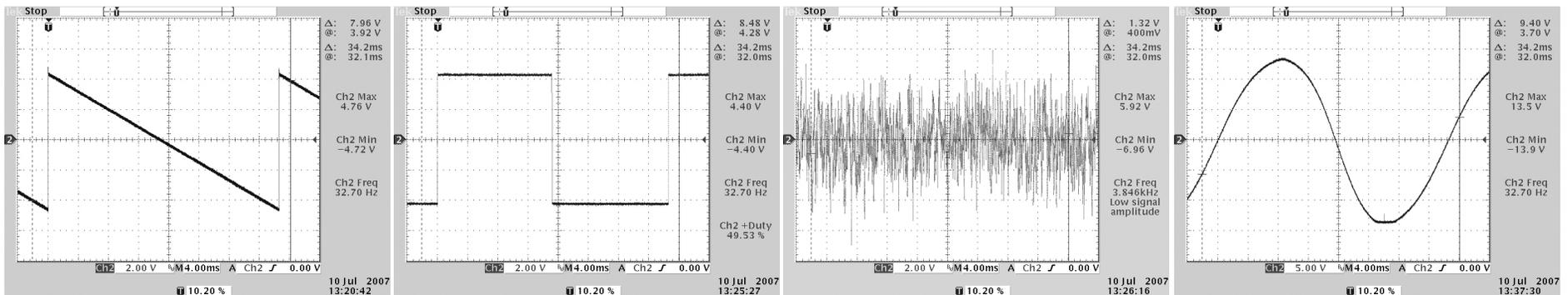
Start with the FINE TUNE control in the 0 position. Play note C2 on your MIDI keyboard and listen to the pitch generated. Rotate the FINE TUNE control fully clockwise and you should the pitch of oscillator A become slightly higher in frequency. Rotate the FINE TUNE control fully counter clockwise and you should the pitch of oscillator A become slightly lower in frequency.

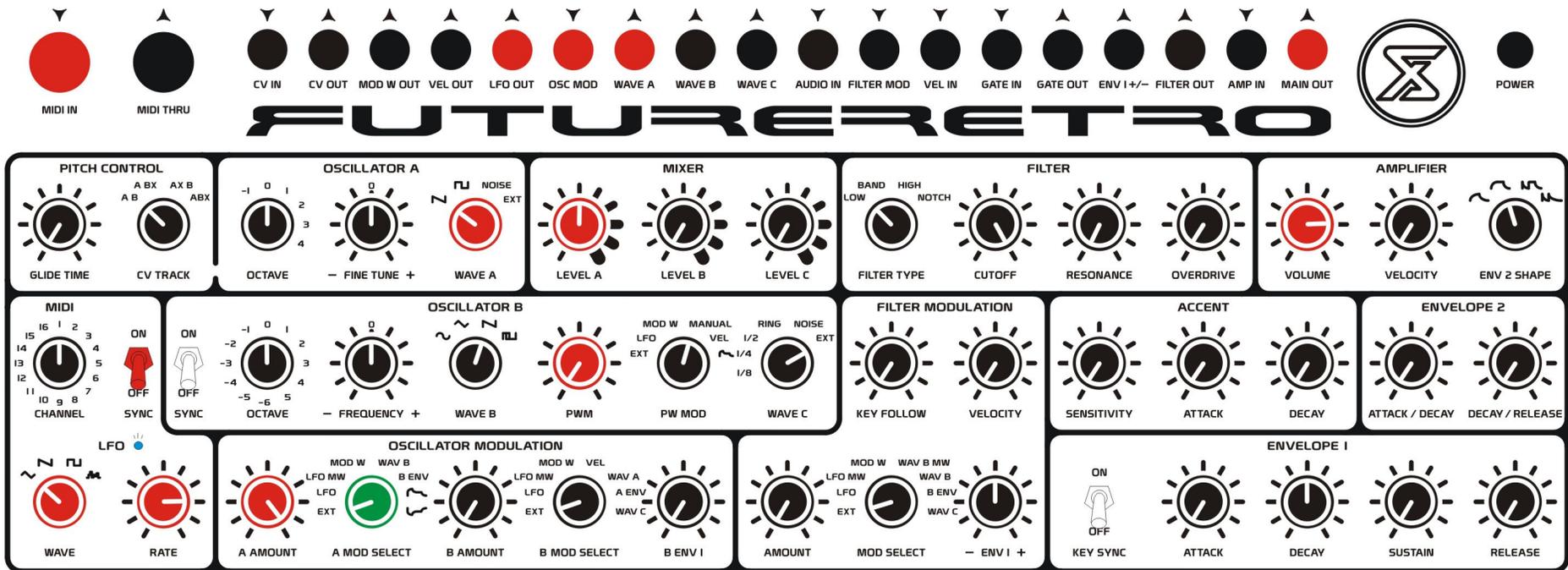


### Step 21, Testing Oscillator A's WAVE Control:

Using a 1/4" cable, connect the WAVE A jack to your oscilloscope. Using another 1/4" cable connect the WAVE B jack to the AUDIO IN jack. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

Rotate the WAVE A control clockwise through its settings. You should see the waveforms displayed in the diagrams below.

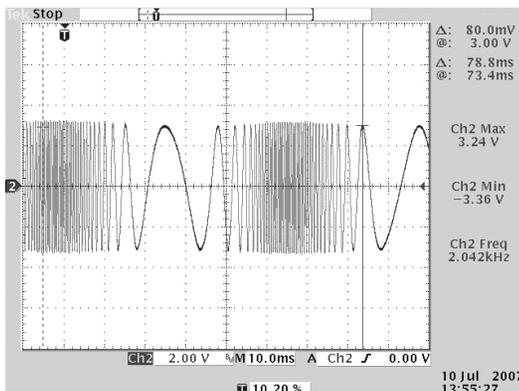




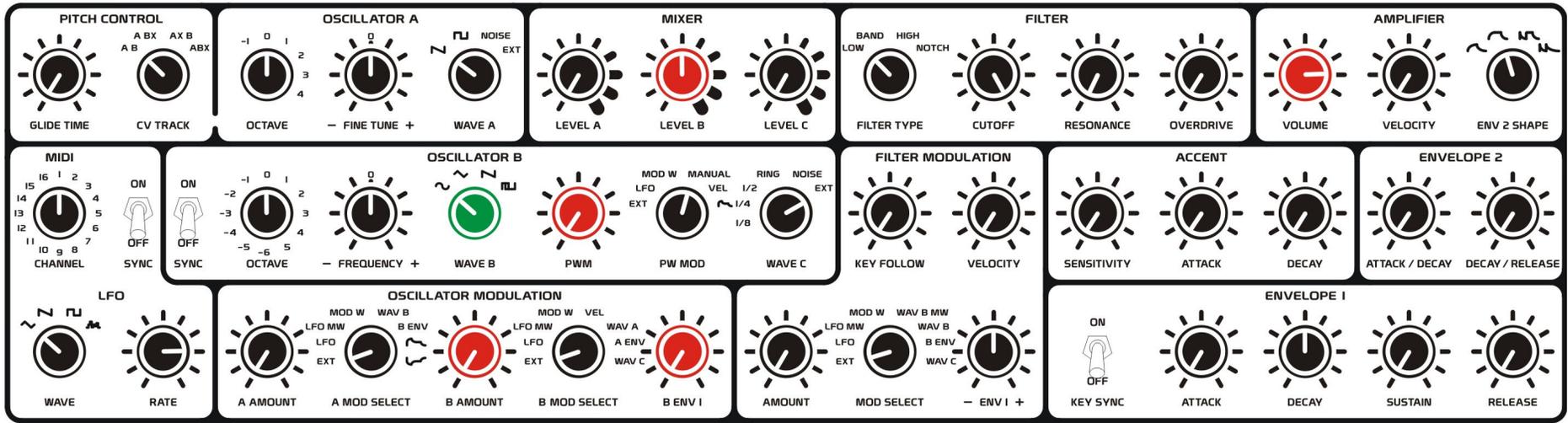
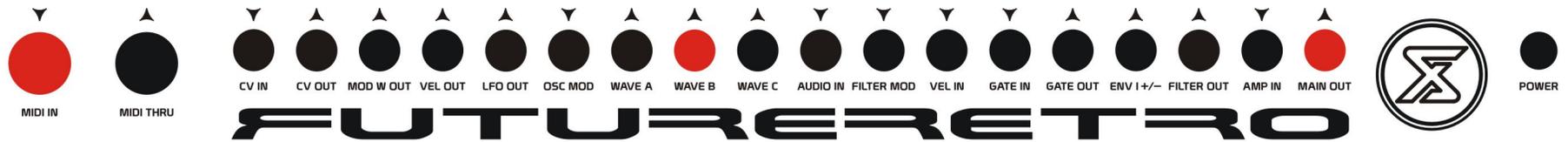
### Step 22, Testing Oscillator A's Modulation Amount:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the MAIN OUT output jack to your audio system. Using another 1/4" cable connect the LFO OUT jack to the OSC MOD jack. If you wish to view the modulated waveform, use another 1/4" cable to connect the WAVE A jack to your oscilloscope. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

Start with the A MOD SELECT switch in the EXT setting. Play note C1 on your MIDI keyboard and you should hear the pitch of oscillator A sweeping up and down at the same rate the LED is blinking in the LFO section. Now change the A MOD SELECT control to the LFO setting. You should hear the exact same effect of the oscillator pitch sweeping up and down, with only a minor offset to the overall pitch.



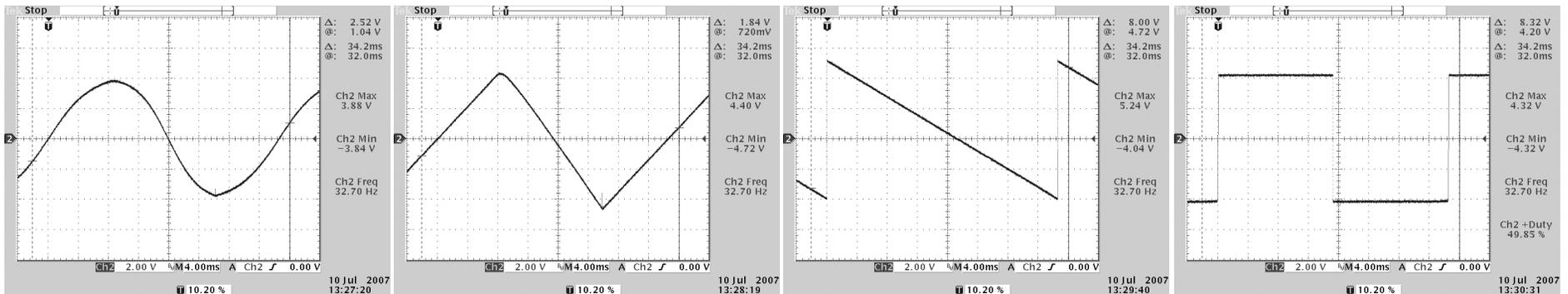
Oscillator A's waveform will look similar to this when being modulated by the LFO.

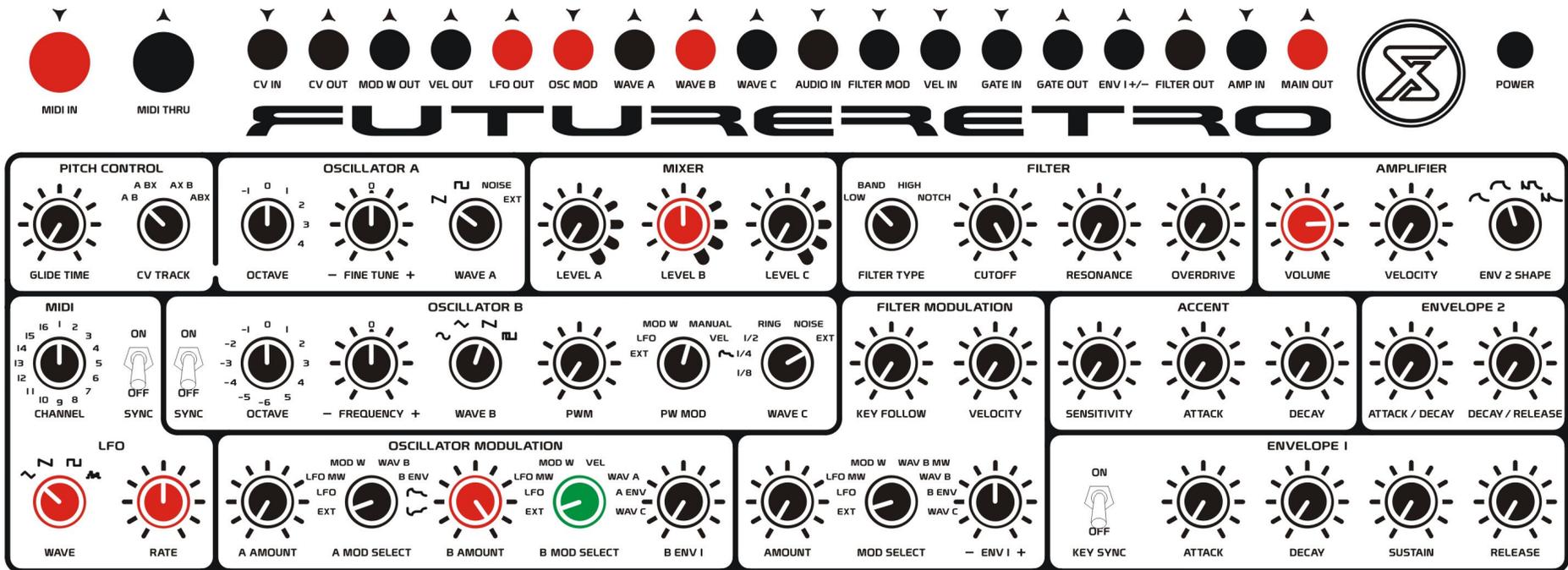


### Step 23, Testing Oscillator B's WAVE Control:

Using a 1/4" cable, connect the WAVE B jack to your oscilloscope. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

Rotate the WAVE B control clockwise through its settings. You should see the waveforms displayed in the diagrams below.

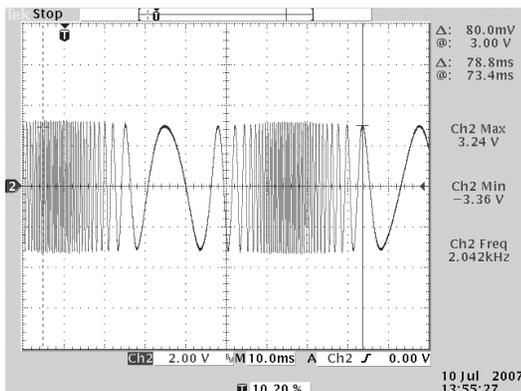




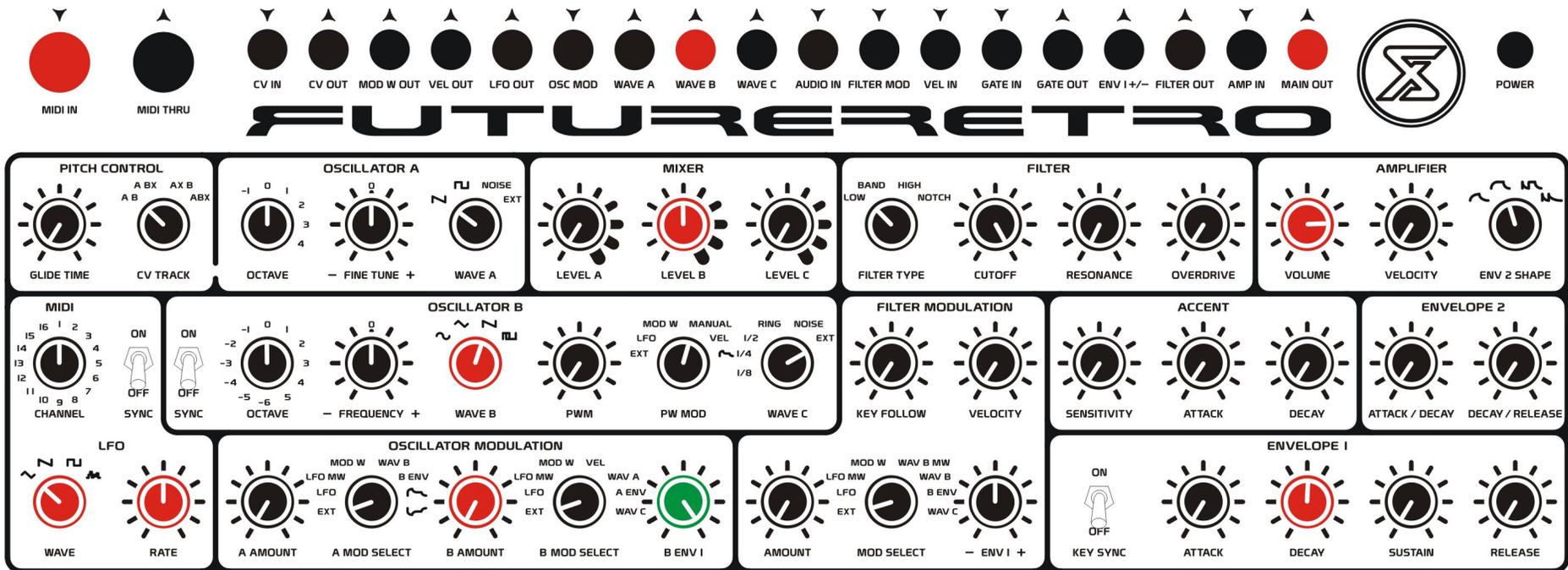
### Step 24, Testing Oscillator B's Modulation Amount:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the MAIN OUT output jack to your audio system. Using another 1/4" cable connect the LFO OUT jack to the OSC MOD jack. If you wish to view the modulated waveform, use another 1/4" cable to connect the WAVE B jack to your oscilloscope. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

Start with the B MOD SELECT switch in the EXT setting. Play note C1 on your MIDI keyboard and you should hear the pitch of oscillator B sweeping up and down at the same rate the LED is blinking in the LFO section. Now change the B MOD SELECT control to the LFO setting. You should hear the exact same effect of the oscillator pitch sweeping up and down, with only a minor offset to the overall pitch.



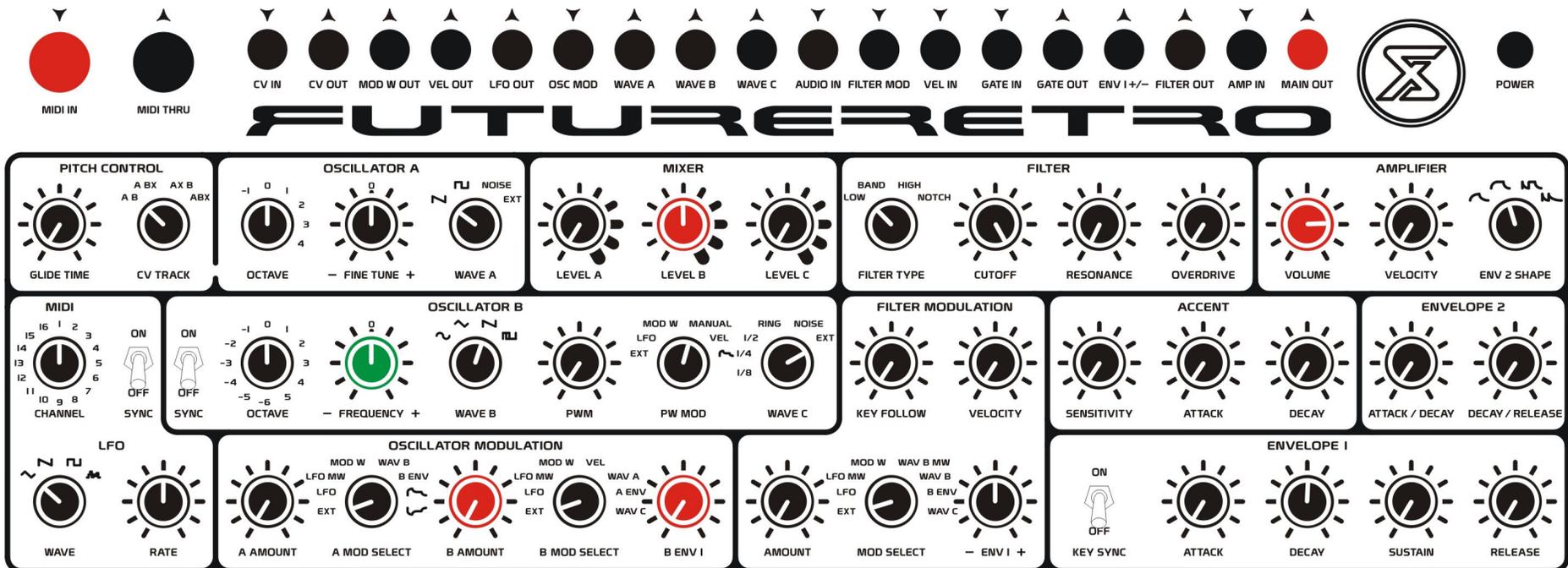
Oscillator B's waveform will look similar to this when being modulated by the LFO.



**Step 25, Testing Oscillator B's ENV 1 Sweep Amount:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the MAIN OUT output jack to your audio system. If you wish to view the modulated waveform, use another 1/4" cable to connect the WAVE B jack to your oscilloscope. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

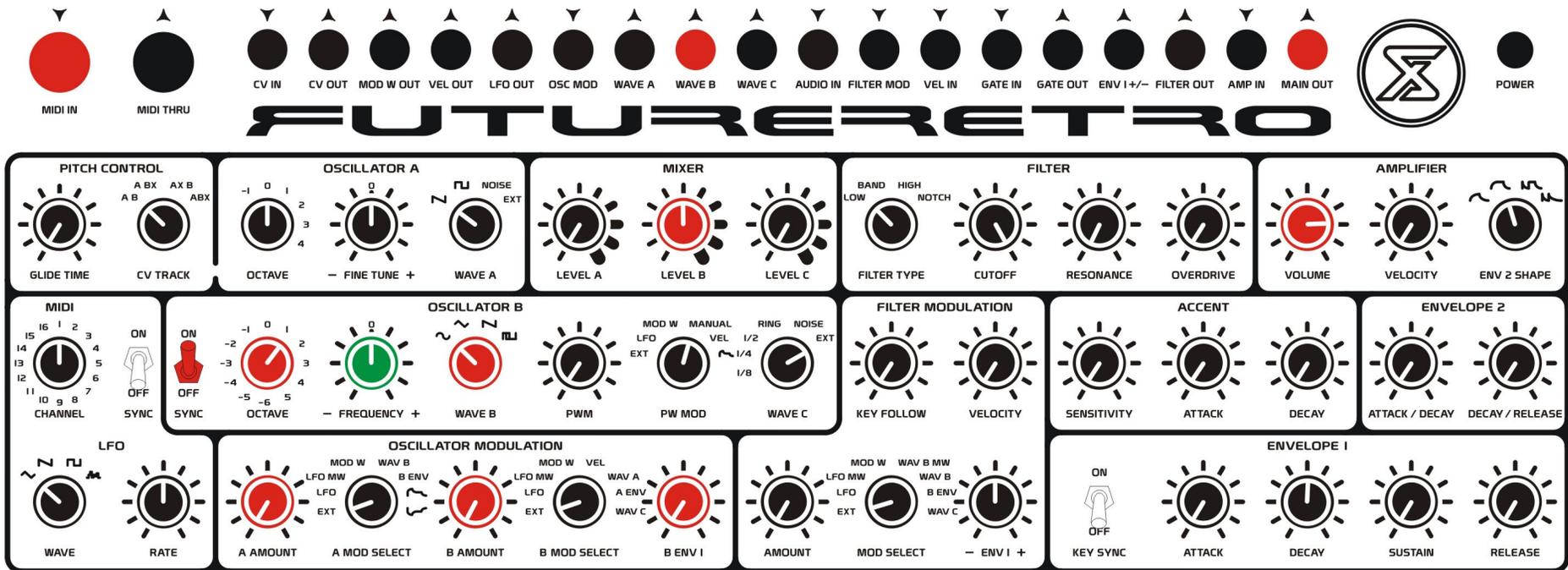
Start with the B ENV 1 control rotated fully counter clockwise. Play note C1 on your MIDI keyboard and you should hear the pitch of oscillator B generating a steady tone. Rotate the B ENV 1 control fully clockwise and you should hear the pitch of oscillator B sweeping from high to low as each new note is played.



### Step 26, Testing Oscillator B's Frequency Control:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the MAIN OUT output jack to your audio system. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

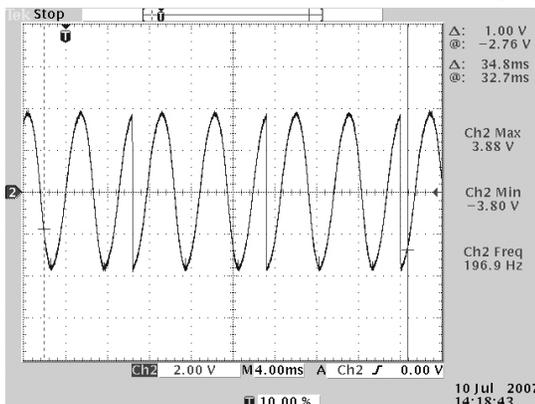
Start with the FREQUENCY control in the 0 position. Play note C2 on your MIDI keyboard and listen to the pitch generated. Rotate the FREQUENCY control fully clockwise and you should the pitch of oscillator B become nearly 9 semitones higher in frequency than the 0 setting. Rotate the FREQUENCY control fully counter clockwise and you should the pitch of oscillator B become nearly 9 semitones lower in frequency.

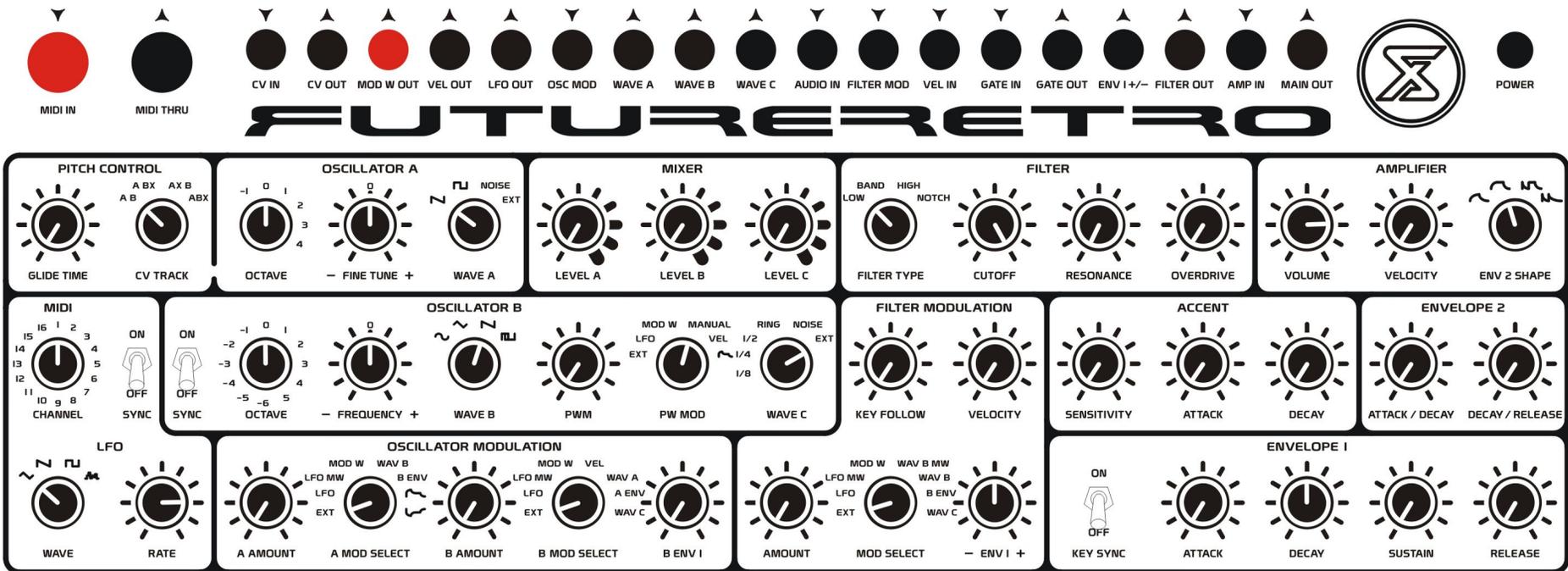


### Step 27, Testing Oscillator B's Frequency Sync:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the MAIN OUT output jack to your audio system. If you wish to view the modulated waveform, use another 1/4" cable to connect the WAVE B jack to your oscilloscope. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

Start with the FREQUENCY control in the 0 position. Play note C1 on your MIDI keyboard and listen to the pitch generated by oscillator B. It should generate a very nice pure tone. Now rotate the FREQUENCY control clockwise, and you should hear the oscillator B's frequencies becoming more complex and generating more harmonics. When viewing the waveform on an oscilloscope you will notice an abrupt rising or falling edge to show where the waveform is syncing.

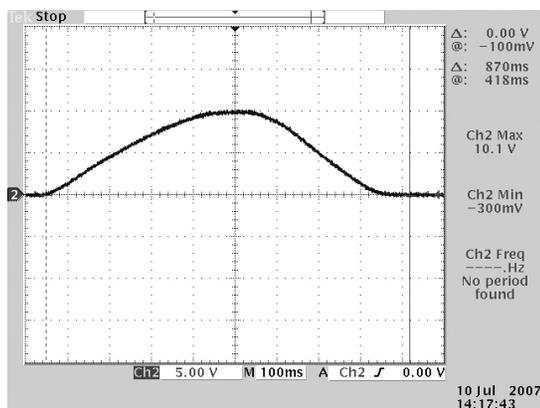


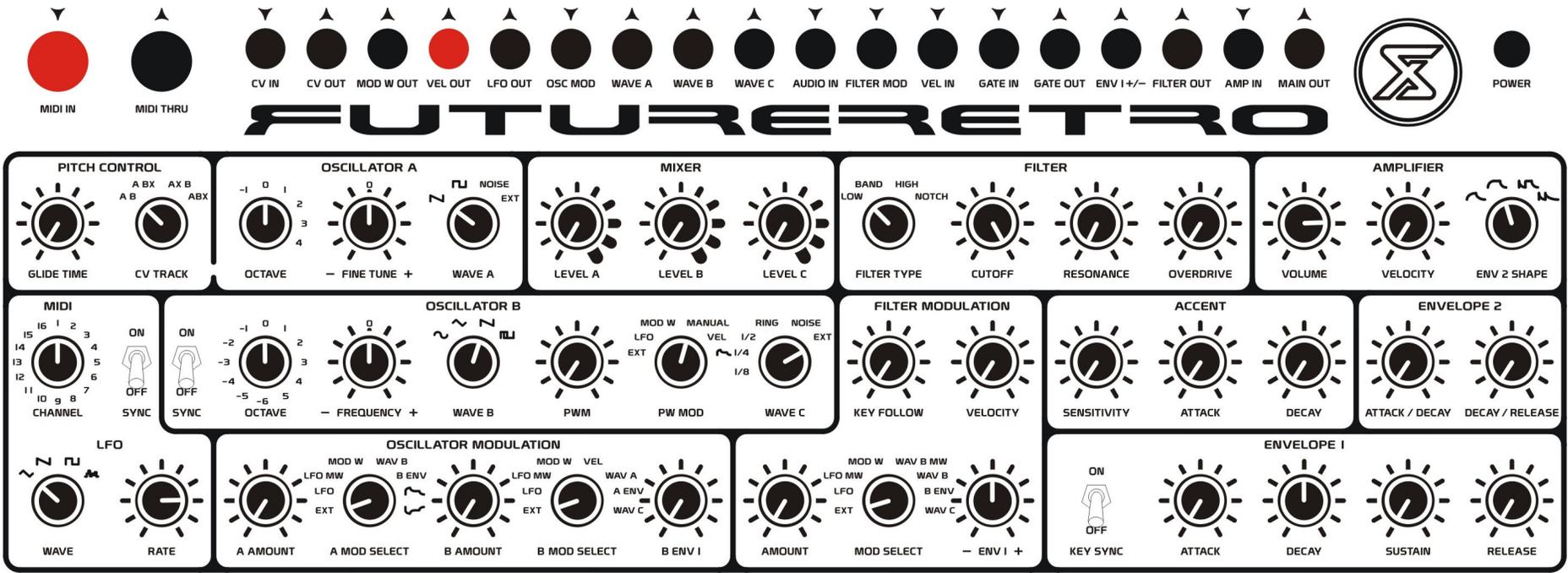


### Step 28, Testing the MOD W OUT:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the MOD W OUT jack to your oscilloscope.

Move the mod wheel controller of your MIDI keyboard through its entire range, and you should see the voltage at the MOD W OUT jack vary from 0 to approximately +10 volts.

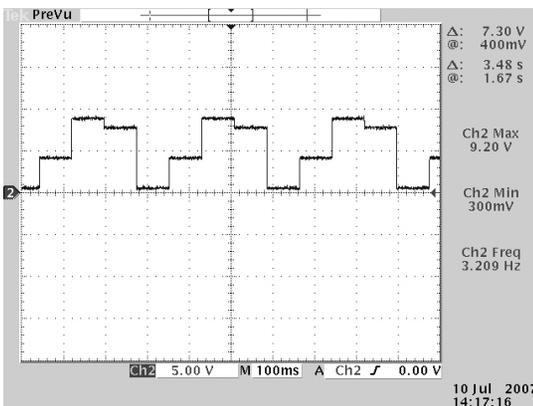


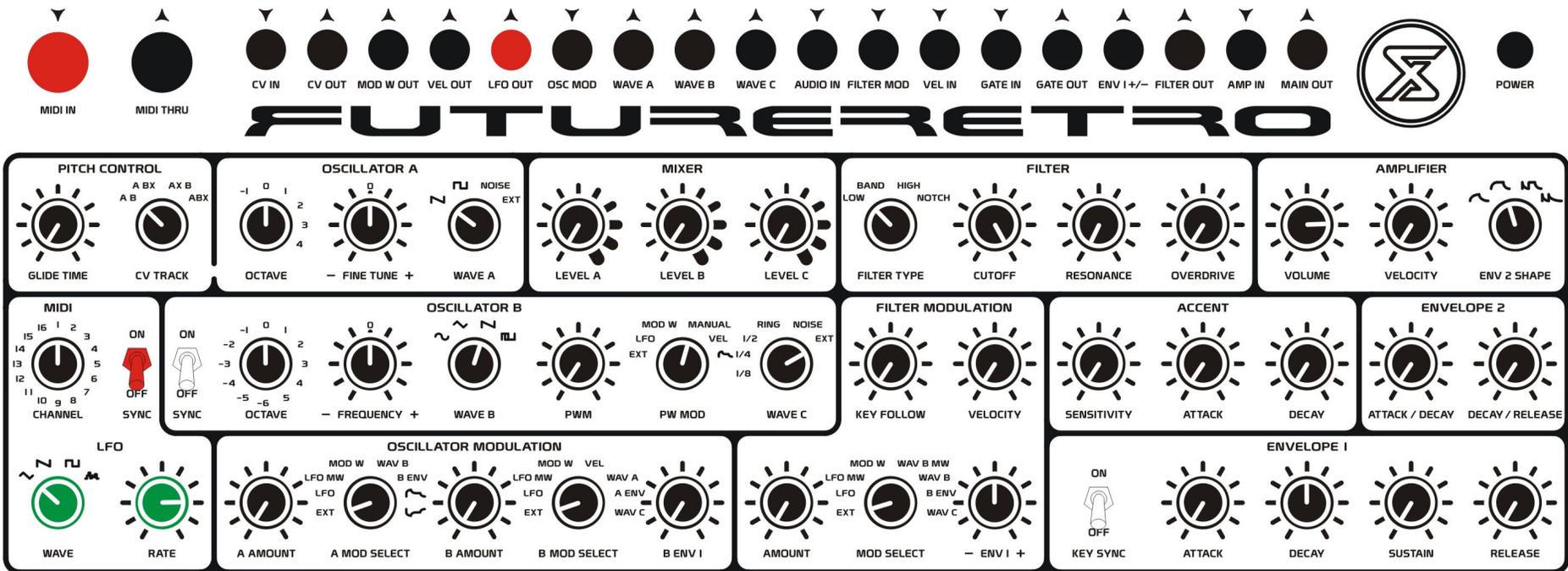


### Step 29, Testing the VEL OUT:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the VEL OUT jack to your oscilloscope.

Play notes at varying velocities (from soft to hard) on your MIDI keyboard, and you should see the voltage at the VEL OUT jack vary from approximately 0 to +10 volts.

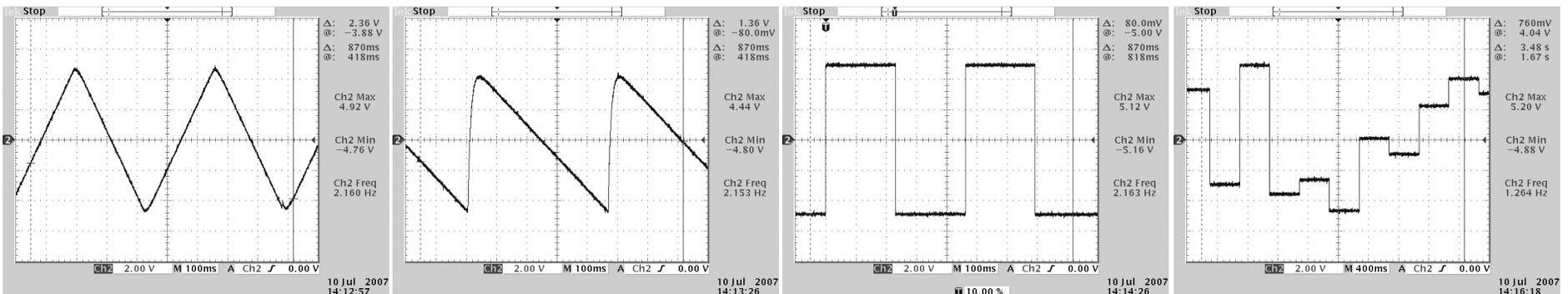


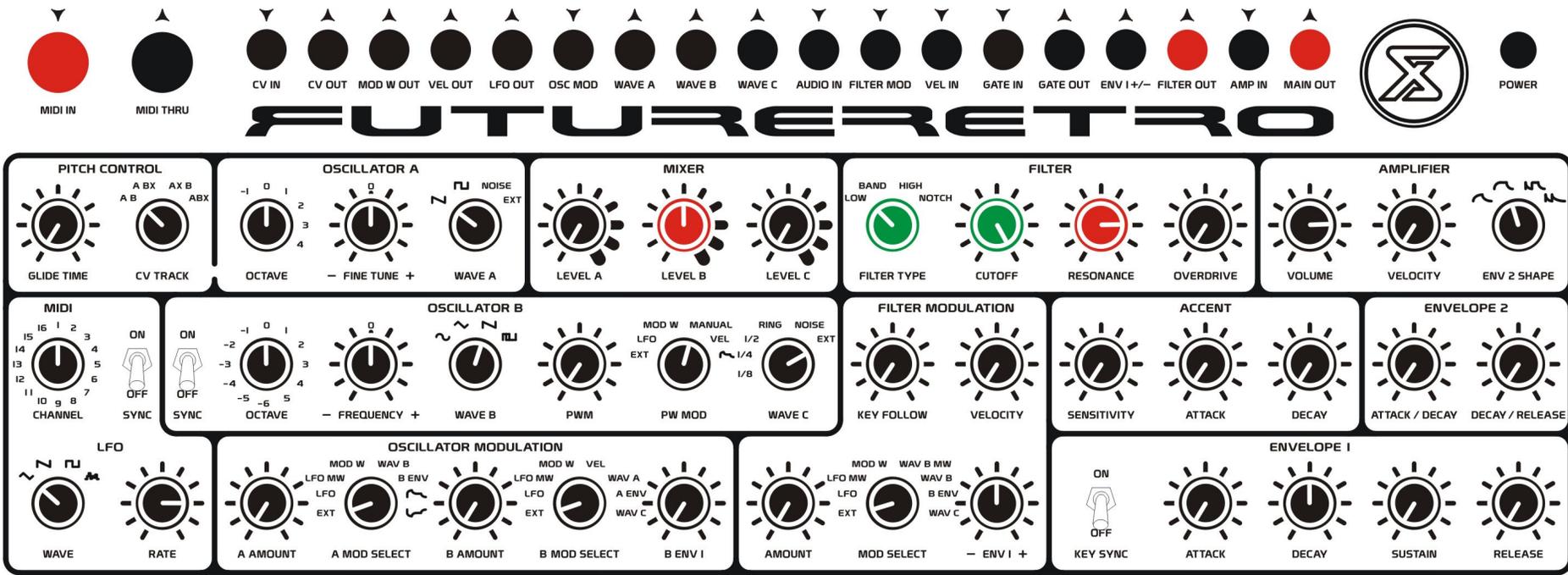


### Step 30, Testing the LFO:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the LFO OUT output jack to your oscilloscope. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

Rotate the RATE control and check to see that the LED in the LFO section is blinking at the rate set for the LFO. Note: It is normal for the LED to not blink consistently when the random waveform is selected for the LFO. Rotate the WAVE control through the 4 different positions and see that each waveform generated looks like the diagrams below. All LFO waveforms will have a range of -5 to +5 volts.





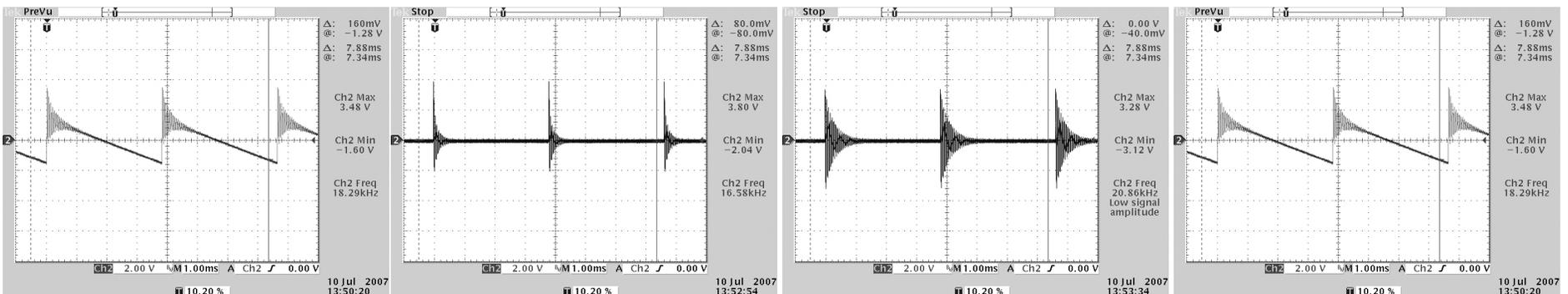
### Step 31, Testing the FILTER TYPE:

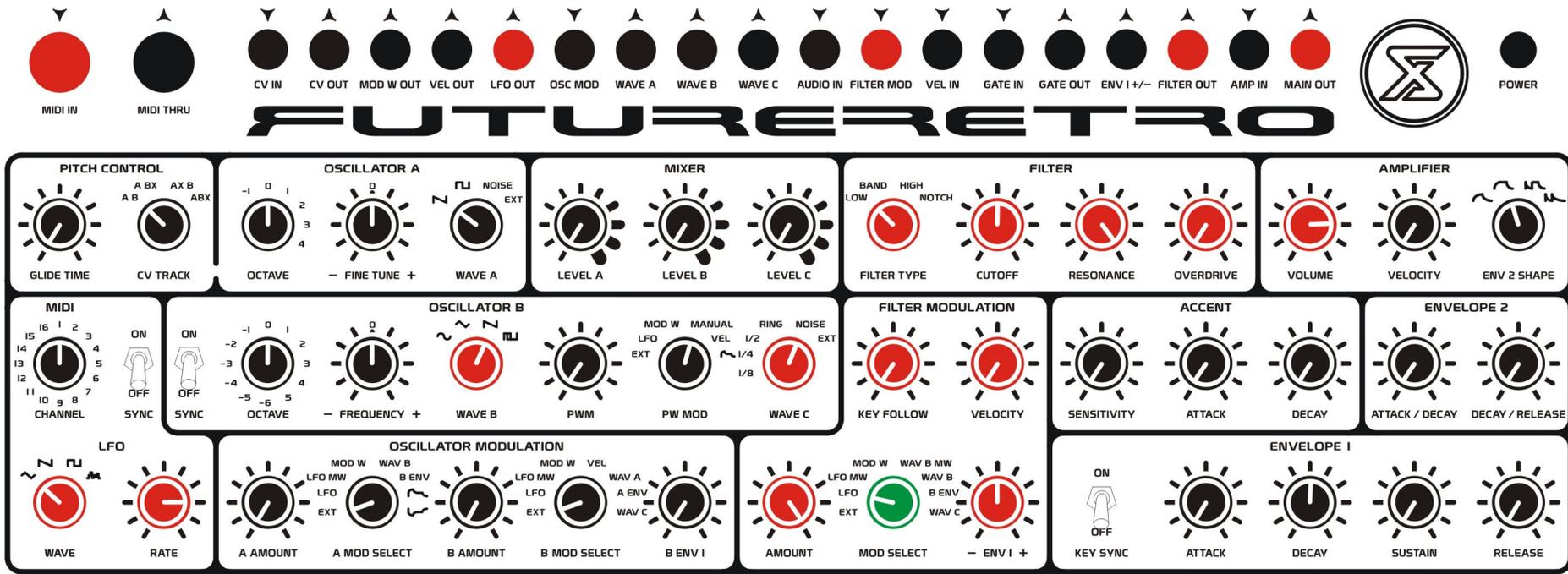
Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the FILTER OUT jack to your oscilloscope. Using another 1/4" cable connect the MAIN OUT jack to your audio system. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

Play C4 on your MIDI keyboard, and start with the settings shown above.

Rotate the FILTER TYPE control clockwise through its settings. You should see the waveforms displayed in the diagrams below.

You can then sweep the filter's CUTOFF control through its full range in each filter type setting to determine if that filter type sounds correct. Note: Low type will remove high frequencies, Band will allow only an isolated amount of frequencies to pass, High will remove low frequencies, and Notch will pass all frequencies while boosting only isolated frequencies. Note: In order to hear the audio you will need to play notes on your MIDI keyboard.

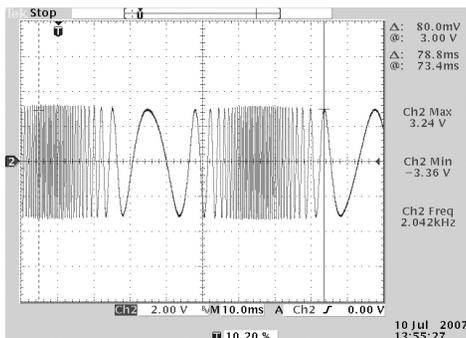




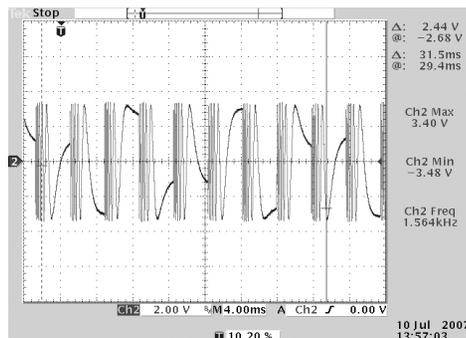
### Step 32, Testing the Filter Modulation Amount:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the FILTER OUT jack to your oscilloscope. Using another 1/4" cable connect the MAIN OUT jack to your audio system. Using another 1/4" cable, connect the LFO OUT jack to the FILTER MOD jack. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

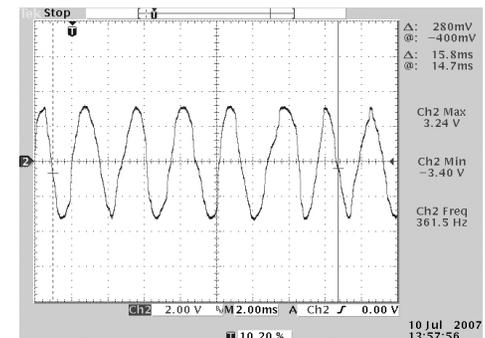
Start with the filter's MOD SELECT control set to EXT. You should see and hear the filter's frequency increasing and decreasing at the rate of the LFO. Now select the LFO setting for the MOD SELECT control. You should hear exactly the same effect to the filter's frequency, looking similar to the diagram on the left. Now select WAV B for the MOD SELECT control, you should see a waveform similar to the middle diagram. Now select WAV C for the MOD SELECT control, you should see a waveform similar to the diagram on the right. Note: In order to hear the audio you will need to play notes on your MIDI keyboard.



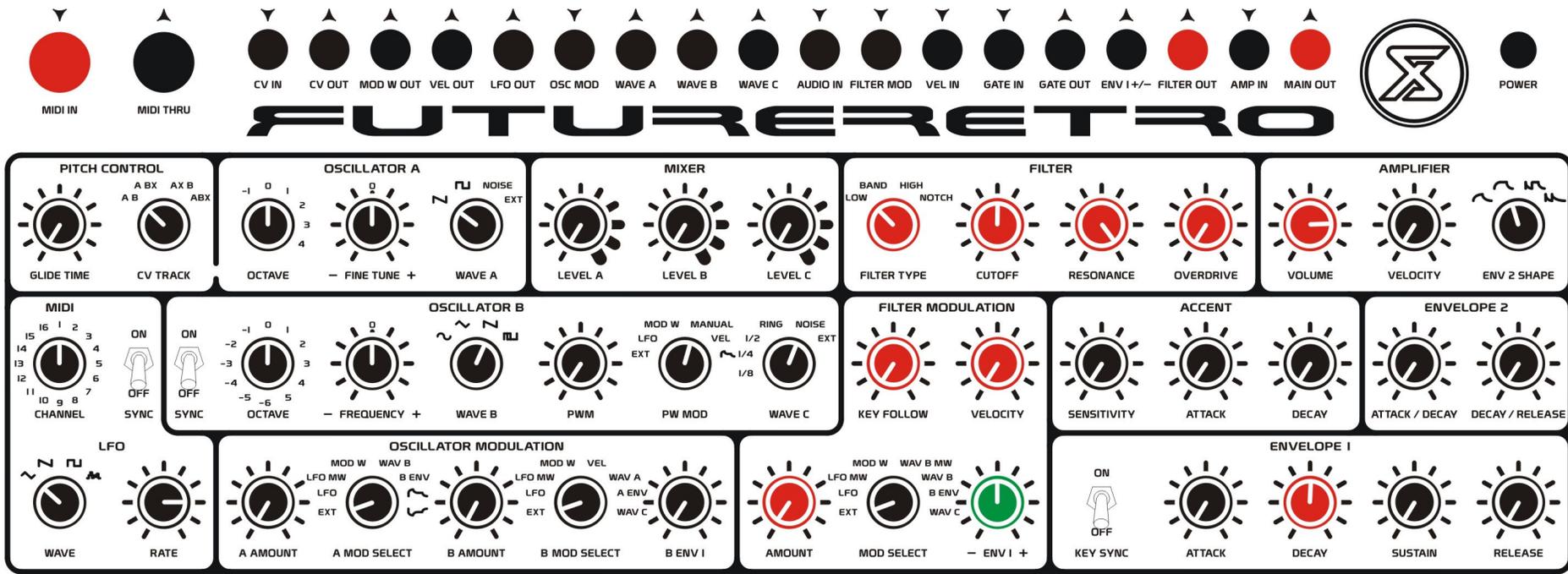
LFO or EXT setting



WAV B setting



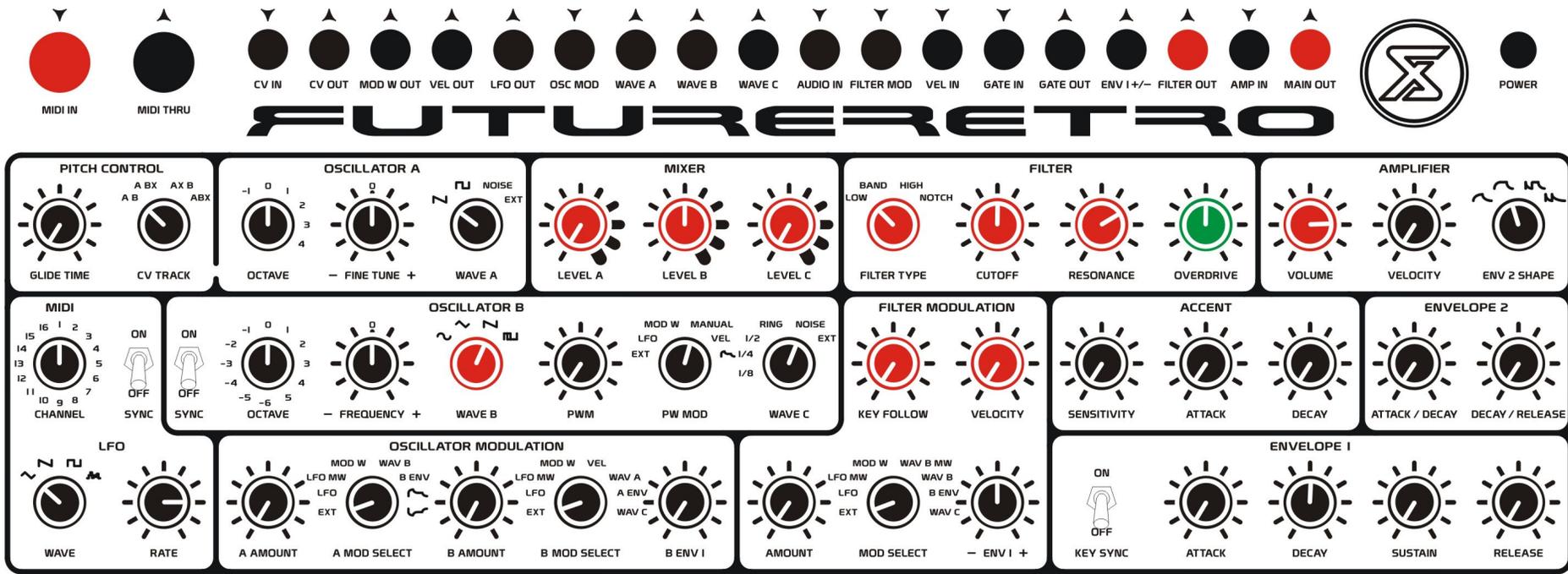
WAV C setting



**Step 33, Testing the Filter’s ENV 1 Sweep Amount:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4” cable, connect the FILTER OUT jack to your oscilloscope. Using another 1/4” cable connect the MAIN OUT jack to your audio system. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

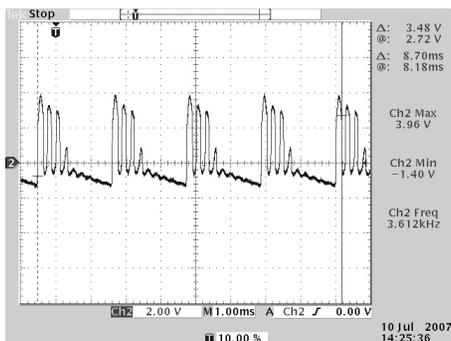
Start with the filter’s ENV 1 control set to its mid position. You should see and hear the filter producing a steady sine wave tone each time a note is played. Now rotate the ENV 1 control in the clockwise direction. You should see and hear the filter’s frequency sweeping from a high to low pitch with each note played. Now rotate the ENV 1 control in the counter clockwise. You should see and hear the filter’s frequency sweeping from a low to high pitch with each note played.

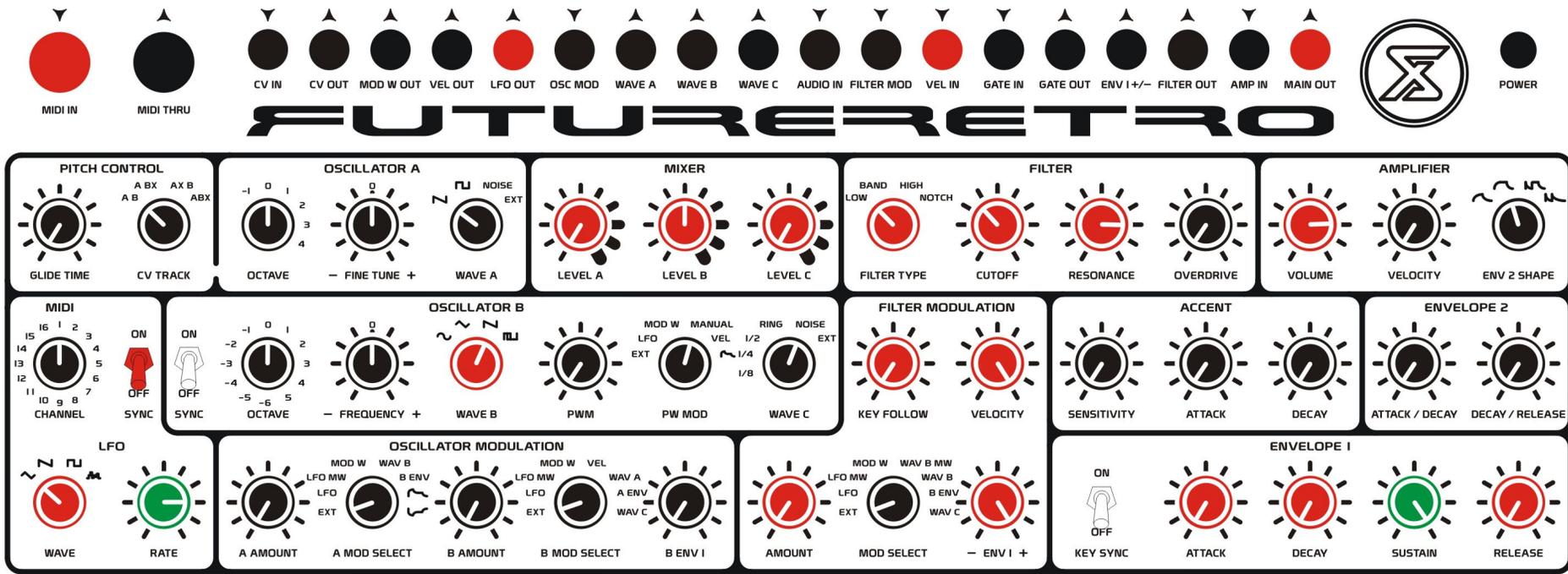


### Step 34, Testing the Filter's Overdrive:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the FILTER OUT jack to your oscilloscope. Using another 1/4" cable connect the MAIN OUT jack to your audio system. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

Start with the filter's OVERDRIVE control set to its mid position. You should see and hear the filter producing an overdriven saw waveform with resonance, similar to the diagram below. When this OVERDRIVE control is rotated fully counter clockwise you should see and hear a clean saw waveform with resonance, with nice rounded edges. When this OVERDRIVE control is rotated fully clockwise you should see and hear a very distorted version of the saw with resonance, which will appear to have squared up edges to its waveform. Note: In order to hear the audio you will need to play notes on your MIDI keyboard.



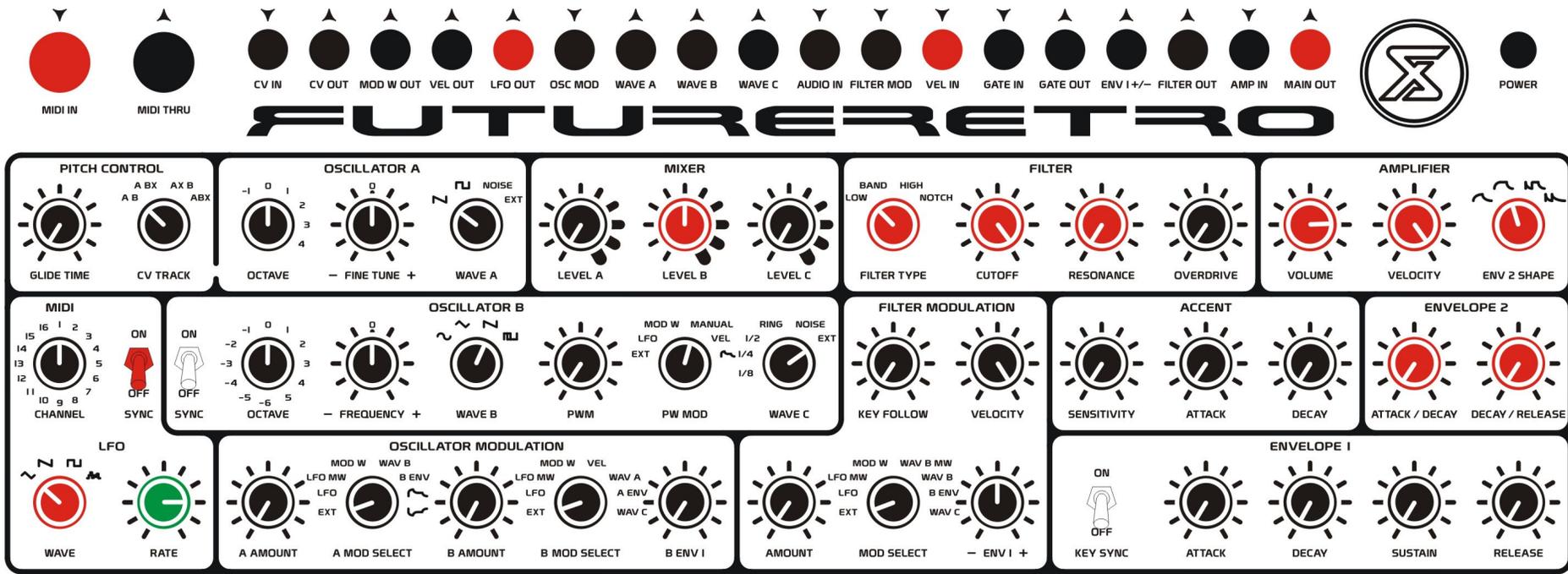


**Step 35, Testing the Filter’s Velocity Amount:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4” cable, connect the LFO OUT jack to the VEL IN jack. Using another 1/4” cable connect the MAIN OUT jack to your audio system. Controls shown in red must be set to the settings as indicated.

Play and hold a note on your MIDI keyboard, and listen to the cutoff frequency of the filter. You should hear the LFO wave shape sweeping the filter’s cutoff frequency increasing and decreasing at the rate the LFO is producing it’s waveform, as its LED flashes to indicate.

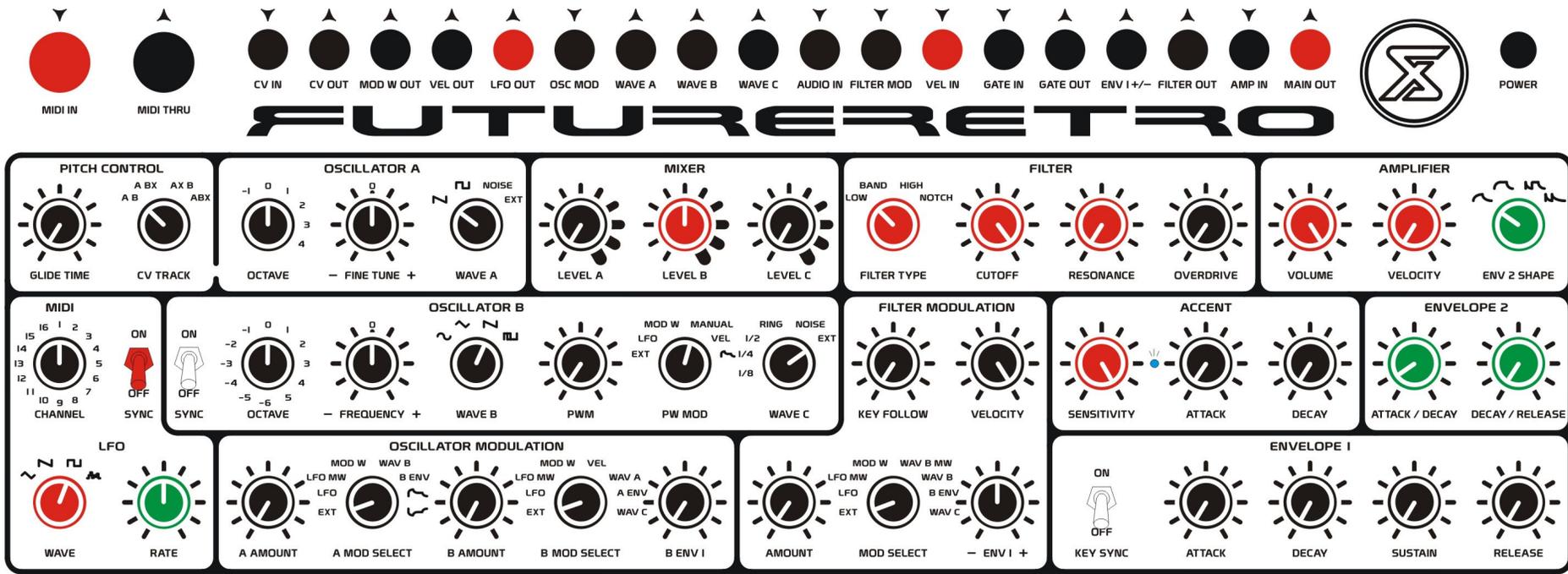
Next completely remove the cable connecting the LFO OUT jack to the VEL IN jack. Play notes on your MIDI keyboard while varying how hard each note is played. You should notice that the harder a note is played (or the higher the velocity value received), the more high frequencies are allowed to pass through the filter.



**Step 36, Testing the Amplifier's Velocity Amount:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the LFO OUT jack to the VEL IN jack. Using another 1/4" cable connect the MAIN OUT jack to your oscilloscope. Controls shown in red must be set to the settings as indicated.

Play notes on your MIDI keyboard, and monitor the amplitude of notes generated at the MAIN OUT jack. You should see and hear the amplitude of the waveforms increasing and decreasing at the rate the LFO is producing it's waveform, as its LED flashes to indicate.

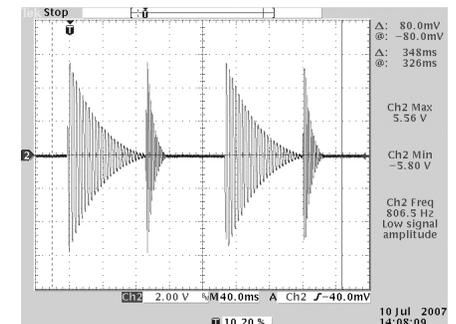
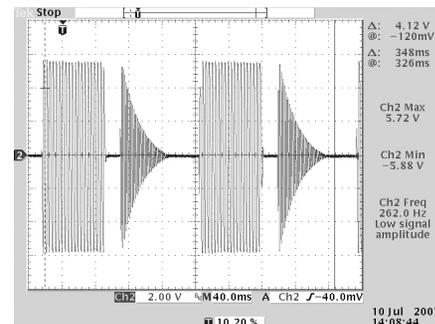
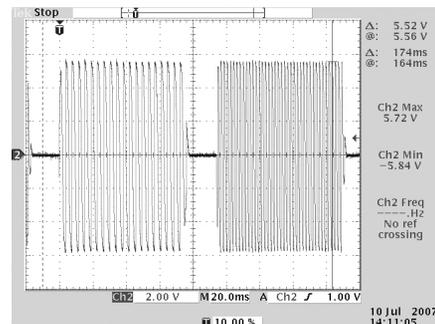
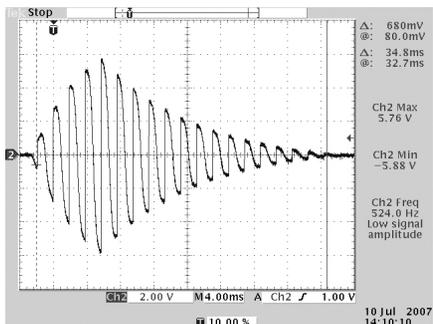


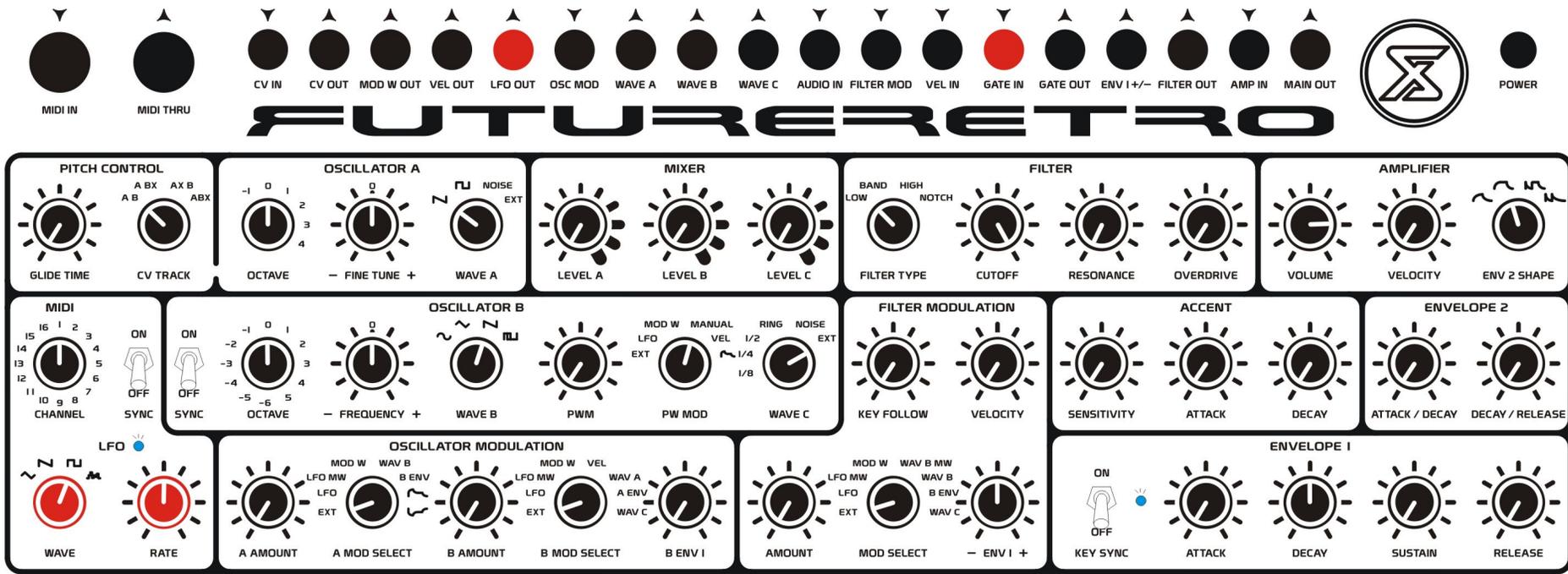
### Step 37, Testing the Envelope 2 Shapes:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the LFO OUT jack to the VEL IN jack. Using another 1/4" cable connect the MAIN OUT jack to your oscilloscope. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

First check to see that the LED in the ACCENT section is blinking on and off at the same rate (although perhaps not the same duration) as the LFO LED is currently blinking at. Rotate the ENV 2 SHAPE control clockwise through its settings as you continuously play note C3 and monitor the envelope shape for each selection. You should see that they are similar to the envelope shapes produced in the diagrams below. In some cases you may need to adjust ENV 2's attack/decay or decay/release amount to match the shapes below. Note: The two last envelope shape selections will vary their shape depending on whether or not the ACCENT LED is on or off when that note is played.

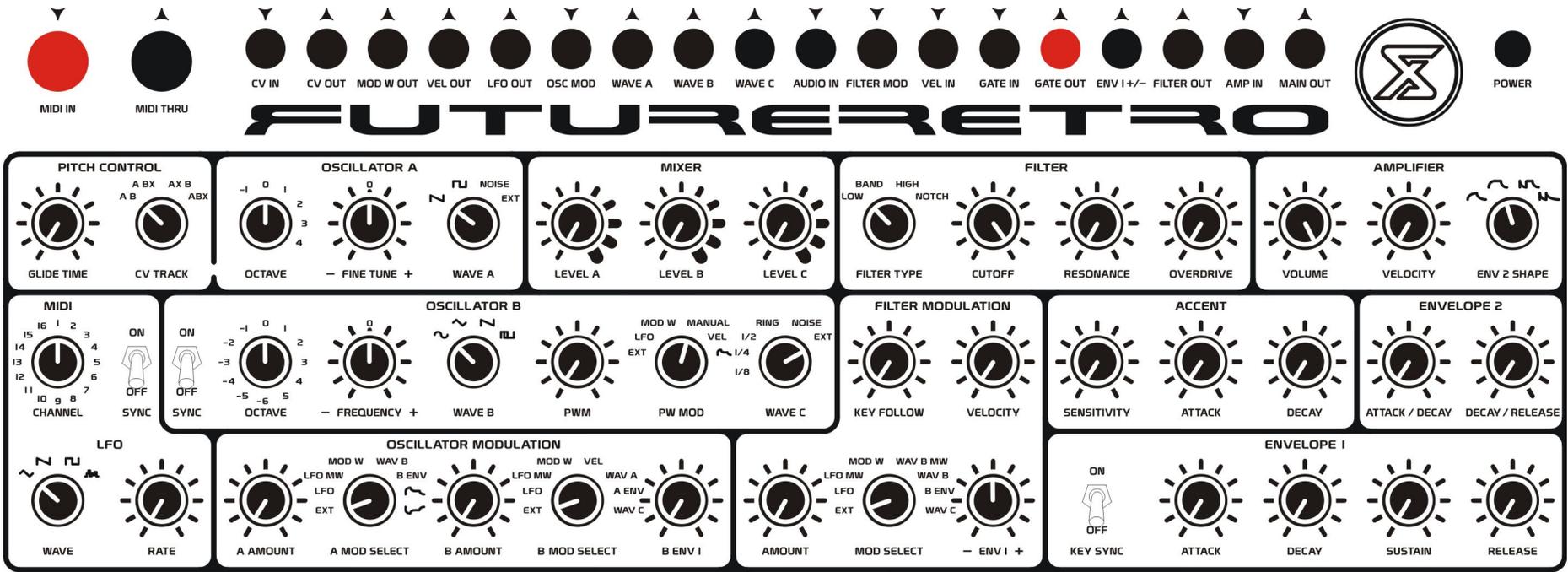
As an alternative method, you could unplug the cable inserted into the VEL IN jack, and instead play notes with varying velocity amounts on your MIDI keyboard. However you would need to set the SENSITIVITY control to its mid position when using this method.





**Step 38, Testing the GATE IN:**

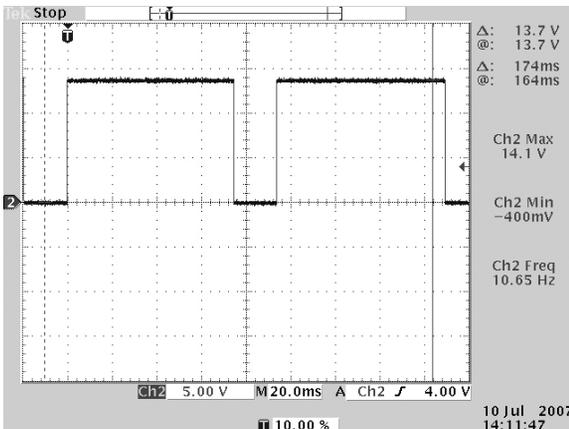
Using a 1/4" cable, connect the LFO OUT jack to the GATE IN jack. Check to see that the LED in the ENVELOPE 1 section is blinking at the same rate and time as the LFO LED is.

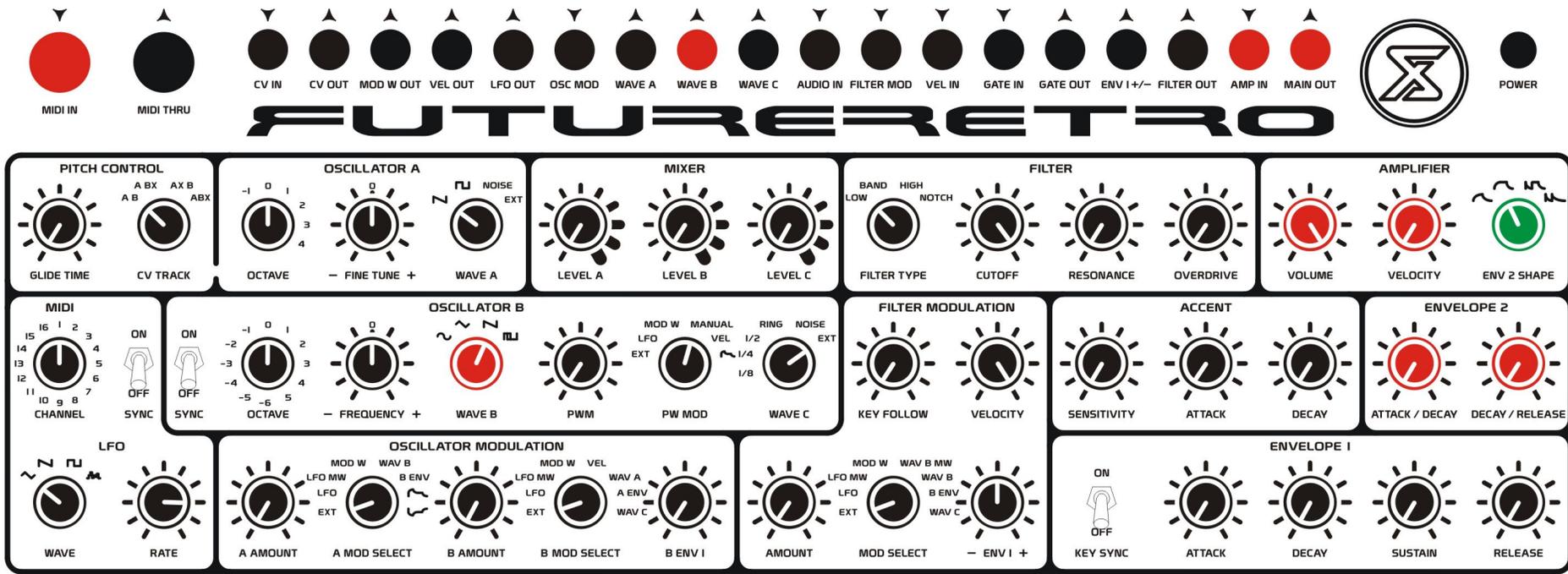


**Step 39, Testing the GATE OUT:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable, connect the GATE OUT jack to your oscilloscope.

Play notes on your MIDI keyboard as you monitor the level of the GATE OUT signal. When no note is being played, this GATE OUT signal should be at 0 volts. When a note is being played, this GATE OUT signal should be at approximately +14 volts.

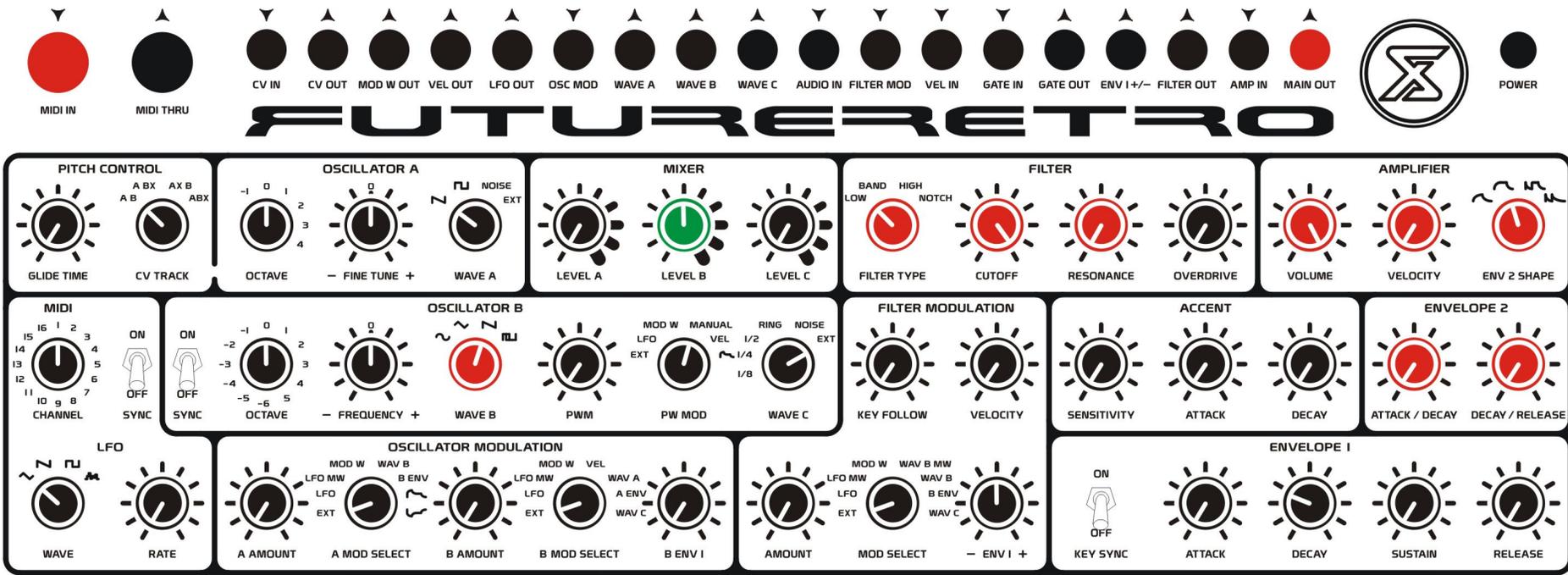




**Step 40, Testing the AMP IN:**

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable connect the WAVE B jack to the AMP IN jack. Using a 1/4" cable, connect the MAIN OUT jack to your audio system or oscilloscope.

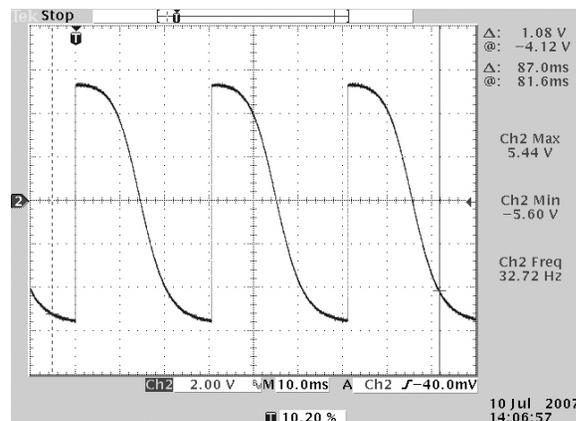
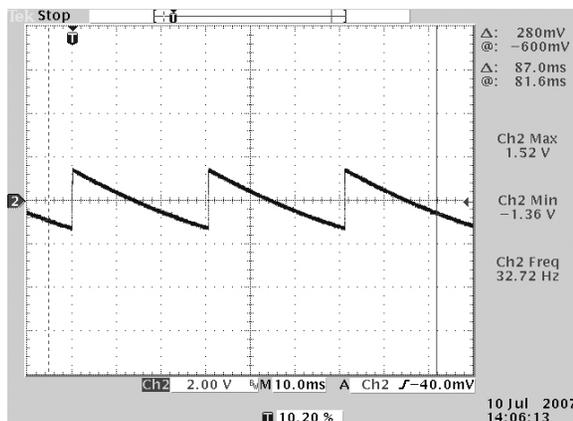
Play and hold a note on your MIDI keyboard as you monitor the MAIN OUT signal. You should see or hear the saw waveform at the MAIN OUT jack. This waveform should have a range of approximately -4 to +4 volts or 8 volts peak to peak.

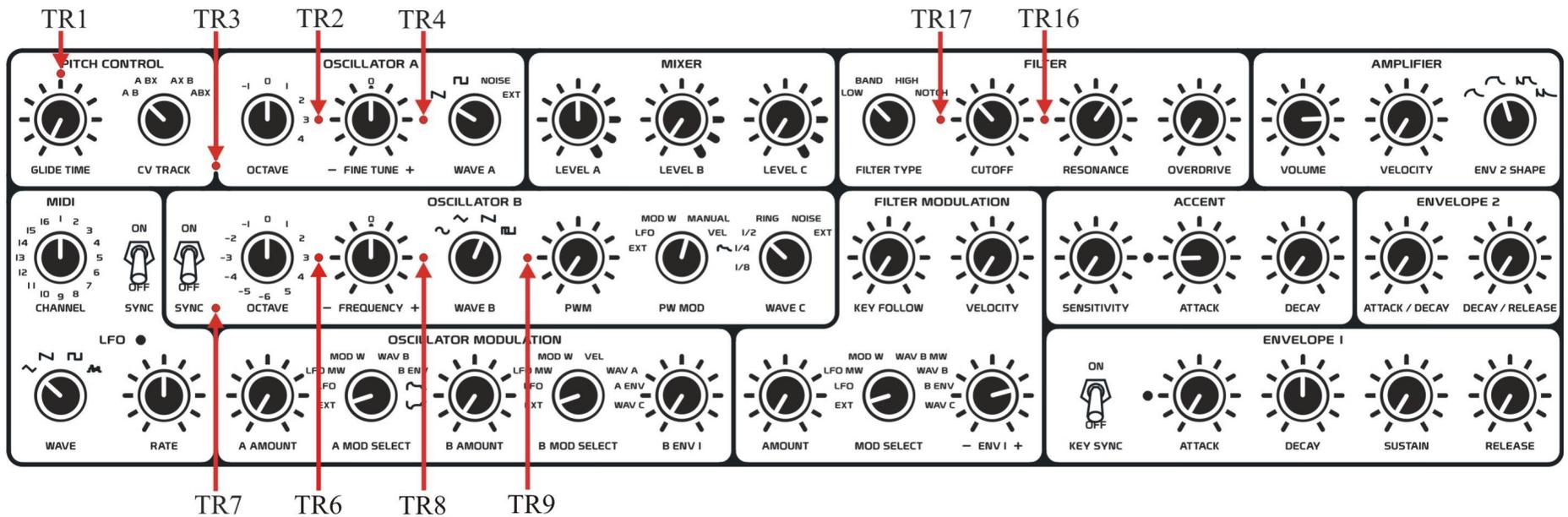


### Step 41, Testing the MAIN OUT:

Connect the MIDI Out of your MIDI keyboard to the MIDI In jack of the XS. Using a 1/4" cable connect the MAIN OUT jack to your oscilloscope. Controls shown in red must be set to the settings as indicated. Controls shown in green will need to be adjusted for this procedure.

Start by setting the mixer's LEVEL B control to its mid position. Play and hold a note on your MIDI keyboard and monitor the level of the MAIN output. You should see a waveform with a level similar to the diagram on the left. Continue to play and hold a note while you turn the LEVEL B control fully clockwise. You should see a waveform with it's level similar to the diagram on the right.





#### Trimmer Locations Reference:

- TR1 - V/Oct CV Output
- TR2 - Oscillator A Scale
- TR3 - Oscillator A Octave Control Scale
- TR4 - Oscillator A Overall Pitch
- TR6 - Oscillator B Scale
- TR7 - Oscillator B Octave Control Scale
- TR8 - Oscillator B Overall Pitch
- TR9 - Oscillator B Pulse Width Duration
- TR16 - Filter CV Tracking
- TR17 - Filter Overall Frequency

*Note: Trimmer locations called out on this page can be adjusted without opening the unit. As these settings are most critical for being calibrated over the years. Although there are other trimmer locations within the unit, you must first disassemble the unit to gain access to them. These hidden trimmer locations should only be recalibrated by Future Retro or a qualified technician.*

*If you do not have the ability to do the procedures in this manual, please contact Future Retro to arrange for us to do the procedure for you.*