# Soundfonts (Polyphone) and jOrgan Tips and Tricks 2.01

What follows is an explanation of many of the settings and effects I have employed in my soundfonts and jOrgan dispositions. I thought it might be useful to others to document them in this way.

## Releases (Soundfont/Polyphone)

While recorded releases may seem to be a better and more authentic option, virtual organ builders have found that there are some drawbacks. One that I found bothersome was an unsynchronized stutter, especially noticeable in reed samples. (It would sound like an extra "brr-bipp" at the release.) Another virtual organ builder who works mostly with Hauptwerk and GrandOrgue has noticed a problem with phase. (See RELEASE ALIGNMENT IN SAMPLED PIPE ORGANS - PART 1 by Nick Appleton.) If the phase isn't just right, the waveform of the sustain and the waveform of the release can cancel each other out if waves are not aligned, so sometimes the release will sound right, sometimes there will be a short period of silence. (Perhaps the "brr-bipp" I heard on release was not just synchronization, but phase cancellation!)

Because of the "stutter," I've preferred to use proportional length releases. After doing some research and analysis of recorded pipe samples, I adopted the settings in the charts below.

### Flues (Principals, Flutes, Strings)

For the release time at key 36 (C1 on the organ keyboard) take pitch in feet x 0.1. For use with modulated detune, take pitch in feet x 0.075.

| *Pitch in feet* | *Release length* | *With modulated detune* |
|---|---|---|
| 32' | 3.200 | *not advised* |
| 16' | 1.600 | *not advised* |
| 8' | 0.800 | *not advised* |
| 5 1/3' | 0.533 | *not advised* |
| 4' | 0.400 | 0.3 |
| 2 2/3' | 0.267 | 0.2 |
| 2' | 0.200 | 0.15 |
| 1 3/5' | 0.160 | 0.12 |
| 1' | 0.100 | 0.075 |
| 1 1/3' | 0.133 | 0.1 |
| ½' | 0.050 | 0.0375 |

For pitches 4' and above, also apply "Division to the next octave" 2.00, "Detuning induced (semi-tons)" -1.00

### Mixtures

For all mixtures, set release time at key 36 (C1 on the organ keyboard) at .07. (Slightly longer, 0.1, if the mixture is deeper in pitch.) "Division to the next octave" 1.00, "Detuning induced (semi-tons)" -1.00

For a cornet with all pitches recorded together, use the setting for a 2 2/3’ flue as shown above.

### Reeds

For the release time at key 36 (C1 on the organ keyboard) take pitch in feet x 0.015.

| | |
|---|---|
| 32’ | 0.480 |
| 16’ | 0.240 |
| 8’ | 0.120 |
| 4’ | 0.060 |

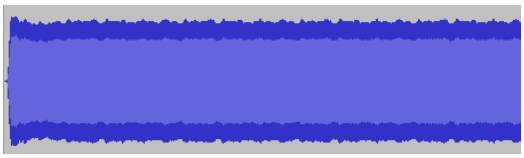
For all pitches also apply “Division to the next octave” 2.00, “Detuning induced (semi-tons) “ -2.00

## Wind Simulation (jOrgan disposition)

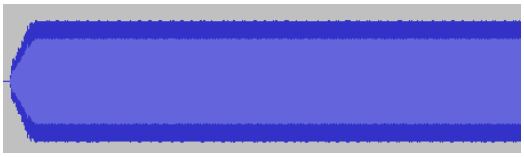
Allen organs built in the late 1960s through the early 1980s had two kinds of wind instability simulation. Random Motion (See U.S. Patent 2989886)and Voice Articulation (See U. S. Patent 3757022). I use the terms to help description of the phenomena. The processes and techniques used to replicate Random Motion and Voice Articulation are achieved by different means in a jOrgan disposition with soundfonts (MIDI messages and Soundfont parameters) than in an Allen analogue or digital organ (special circuits, resistors, transistors, and variable power supplies).

### Random Motion

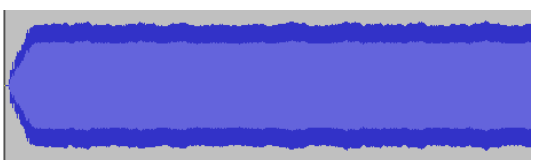
“Random Motion” simulated a slight unsteadiness in the wind supply. (At one time they called it “electronic blower” or “Whind.”) In later models it was called “Random Motion.” It was a very slight but constant random variation in pitch and volume which reduced the “ear fatigue” of constant, unvarying digital or analogue generated organ sounds.



This is what a sample recorded from a pipe looks like. Notice the instability in volume (amplitude). The variance is very slight, but a definite difference from the synthesized sample. The slight wobble in pitch adds warmth. When reverb is added, there is a very slight chorus or celeste effect as the variations in pitch play with the reverberative environment. (No reverb was added to this recorded sample.) Recorded samples do not need random motion / wind destabilization because there already is a natural pitch and volume variance in natural recorded pipe samples. Synthesized samples can benefit from having the effect.



Here’s a synthesized sample of the same note from a similar stop to the one displayed above (short convolution reverb is added). See how the instability is lacking, resulting in straight-line amplitude after the attack of the note. Listening to synthesized samples can lead to “ear fatigue.” It also doesn’t give the reverb environment much to work with.



Here’s the same synthesized sample of the same note with the Wind Destabilizer Engine turned on (short convolution reverb is added). Note the similarity of wobble to the recorded sample above. The sound is richer, and more closely resembles a recorded pipe sound.

## Random Motion / Wind Destabilization Engine (New Method)[i]

To replicate the effect, this method uses the newly discovered use for vibrato and employs an "engine" that generates the randomized pattern. There are several advantages of building the engine over the old method of many pitch altering switch filters played in sequence:

- Because of the use of vibrato, this has smoother wobbles and variants than the pitch-drop.
- The settings on the elements of the engine are easier to adjust for wild or mild destabilization.
- Vibrato commands will not interfere with any pitch-altering switch filters or continuous filters.
- There are also fewer elements.

The "engine" has three "cylinders." Prepare them this way:

| **CYLINDER 1** | **CYLINDER 2** | **CYLINDER 3** |
|---|---|---|
| WIND_BLANK_1 (Switch Filter) | WIND_BLANK_2 (Switch Filter) | WIND_BLANK_3 (Switch Filter) |
| WIND_FILTER_1 (Switch Filter) | WIND_FILTER_2 (Switch Filter) | WIND_FILTER_3 (Switch Filter) |
| WIND_SYNCH_1A (Synchronizer) | WIND_SYNCH_2A (Synchronizer) | WIND_SYNCH_3A (Synchronizer) |
| WIND_SYNCH_1B (Synchronizer) | WIND_SYNCH_2B (Synchronizer) | WIND_SYNCH_3B (Synchronizer) |

WIND_FILTER_1 will have a duration of 70 (msec) with this message:

| | |
|---|---|
| Engaged | set 176, set 1, set 2 |

WIND_BLANK_1 will have a duration of 797 (msec) with this message:

| | |
|---|---|
| Engaged | Set 176, set 1, set 0 |

WIND_FILTER_2 is identical to WIND_FILTER_1 except the last MIDI message is "set 3."

WIND_BLANK_2 will have a duration of 594 (msec) with the same Engaged message as above in WIND_BLANK_1.

WIND_FILTER_3 is identical to WIND_FILTER_1 except the last MIDI message is "set 4."

WIND_BLANK_3 will have a duration of 318 (msec) with the same Engaged message as above in WIND_BLANK_1.

WIND_SYNCH_1A references WIND_FILTER_1 and WIND_BLANK_1. When engaged: IGNORE, when disengaged: ENGAGE. This will turn on WIND_FILTER_1 when WIND_BLANK_1 disengages.

WIND_SYNCH_1B references WIND_BLANK_1 and WIND_FILTER_1. When engaged: IGNORE, when disengaged: ENGAGE. This will turn on WIND_BLANK_1 when WIND_FILTER_1 disengages. (Thus making the two switch filters switch on and off alternately.)

Follow the same procedures for the second and third cylinders.

Reference all organ voice ranks to all WIND_FILTER and WIND_BLANK switch filters.

Make a combination and call it "WIND ENGINE TRIGGER COMBINATION" that references WIND_BLANK_1, WIND_BLANK_2, and WIND_BLANK_3 and also references the "Set" button. (You may have to set the duration of the BLANKs to "until deactivated" temporarily.) Turn all three on. Hit "Set"

and then "WIND ENGINE TRIGGER COMBINATION." Return the three WIND_BLANK_*N* switch filters to their original durations (or wait until this point to enter those values).

Make an activator and call it WIND DESTABILIZER. Reference all the WIND_SYNCH synchronizers to it.

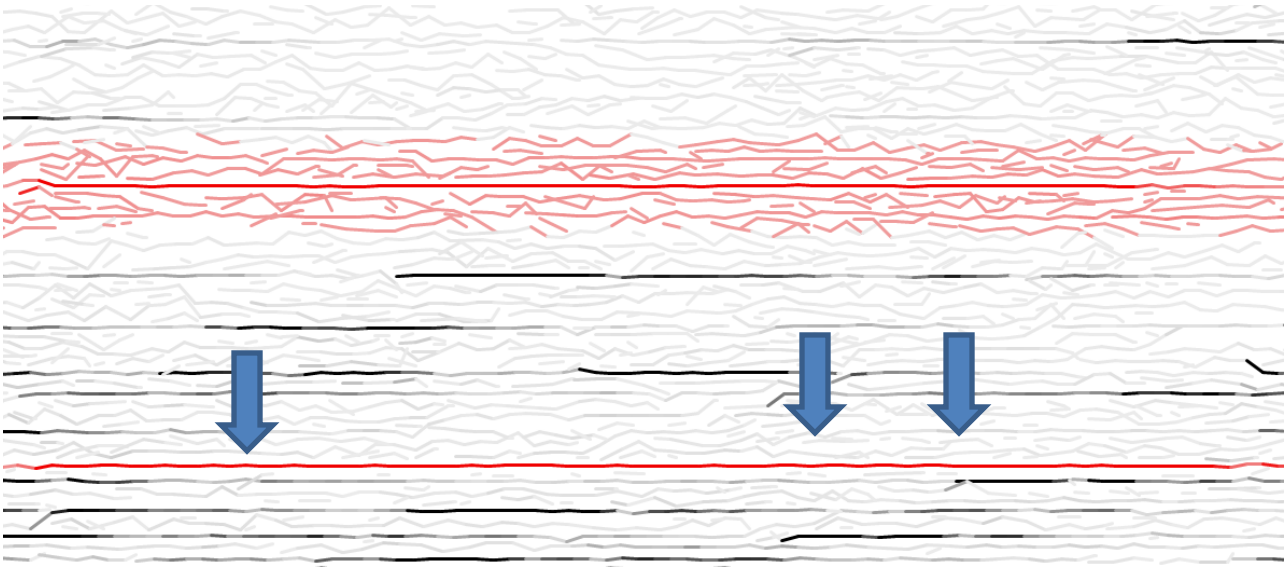
Make a synchronizer and call it WIND ENGINE TRIGGER SYNCH. Reference WIND ENGINE TRIGGER COMBINATION and WIND DESTABILIZER (Activator) to it. When activated: ACTIVATE. When deactivated: ACTIVATE.

Turn it on. The WIND_BLANK filters will space out the WIND_FILTER action at regular intervals, but in such a way that combined with the other two, the frequency of pitch variance will seem random. The combination gets everything going, and then when the engine is switched off, the combination is engaged again to engage the "BLANKs" making sure the vibrato is off. The three blanks can be set to shorter durations (use random.org to get a randomized integer) for a "wilder" destabilization, or to longer durations for a "milder" destabilization. The WIND_FILTER_*N* settings of "set 176, set 1, set *N*" can also be raised for a wilder effect.

## Voice Articulation / Flexible Wind (New Method)[ii]

Voice Articulation simulates the slight variance in pitch that is experienced when other passing notes are played. The phenomenon is often called "Flexible wind" (See article on "Flexible Wind" here). Like Random Motion, this breaks up the steadiness of the pipe tones, and it also adds a little bounce that will liven the sound of the synthetic or recorded samples.

Look at this Spear analysis of a section of BWV 642 as recorded by Walter Kraft near the 1:17 mark:



These ripples are more than the random motion of the wind. They are caused by variations in the wind as other notes are being played.

In Allen's patent for voice articulation (See U. S. Patent 3757022) they used vibrato or tremolo and specified a duration of 70 or 75 msec. There are several advantages to this method over the older method of pitch altering switch-filters.

- First, since it uses vibrato, it is smoother and more natural than a sudden pitch variance.
- Second, it will not interfere with any other continuous filters or switch filters that affect pitch.

- Third, It is also easier to adjust depth of the vibrato for wild to mild implementation of the effect.

In the soundfont, give each instrument's "Vib LFO Freq (Hz)" a global value of 14.285. (This makes a single cycle of the vibrato 70 msec.)

In the disposition, make a switch filter and call it "Flexible Wind Vibrato." Give it a duration of 70. Give it these MIDI messages:

| | |
|---|---|
| Engaged | set 176, set 1, set *15* |
| Disengaged | set 176, set 1, set 0 |

The "set 15" can be adjusted upward for "wilder" or downward for "milder." 10 is near the bottom end of "milder." Lower than 10 is hard to detect (but seems to work well for the Random Motion effect).

Reference the "Flexible Wind Vibrato" to all ranks.

Create switch and call it "Flexible Wind Input Switch" and give it an Activate message…

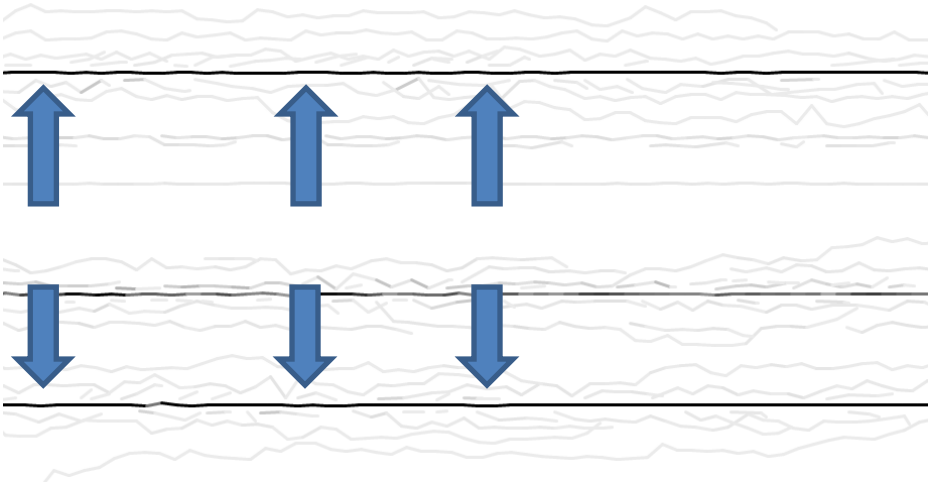
| | |
|---|---|
| Activate | greaterEqual 144 \| lessEqual 159, lessEqual 96 \| greaterEqual 36, greater 5 |

…Reference it to the jOrgan MIDI merger with a special connector. This will respond to all activity from all MIDI devices referenced to jOrgan MIDI merger. Give the Input Switch the same duration as the switch filter.

Make a synchronizer and name it "Flexible Wind" and reference the Input Switch and the switch filter. Set the synchronizer "When activated: ACTIVATE" "When deactivated: IGNORE." Put the synchronizer on the console, and the Flexible wind simulation can be turned on or off.

Even though it doesn't matter, I set the duration of the input switch and the switch filter the same.

Wind Destabilization Engine (new method) and the Flexible Wind (new method) are fully compatible with each other and can be used independently or together. Flexible wind's "set 176, set 1, set *N*" value should be higher so it will be more pronounced than the variations in the Wind Destabilization.



Spear analysis of a note played with vibrato flexible wind simulation.

**CAUTION:** The only caution is for those who use the "set 176, set 1, set *N*" as the command for the tremulants. A new alternative method for tremulants is described later in this document—a method that lets you adjust frequency, pitch and amplitude in the disposition.

## Continuous Pitch Adjustment (jOrgan disposition)

Make a continuous filter and label it "Tuning Adjust." Duration is infinite. Give it the message…

| | |
|---|---|
| Engaging | set 224, set 0, set value \| mult 25 \| add 51 |

…and reference it to all ranks.

To make a "Reset," make a combination, label it "RS" and put it near the continuous "Tuning Adjust." Reference the Reset combination to the Tuning Adjust continuous filter and to your set button. With the Tuning Adjust at 0.50, hit "Set" and "RS." Slide the tuning up or down and hit "RS" to make sure it returns to 0.50. 0.50 is the standard pitch position (A=440 Hz).

**CAUTION:** While the "set 224" command ''can '' be used to do wind instability effects, it will interfere with the tuning adjustment. To have both wind instability effects and pitch adjustment, the different messages must be used as described here. This isn't a problem if you are using the new vibrato method of Flexible Wind / Voice Articulation.

## Swell Muffle / High Frequency Reduction (Soundfont/Polyphone and jOrgan disposition)

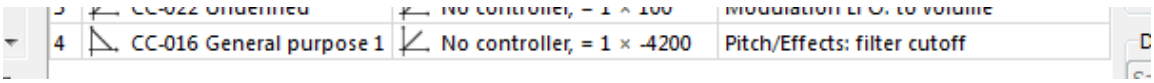
Brighter and higher frequencies are lessened when a swell box is closed. They return when the box is opened. This effect is more than just a change in volume and gives the expression more warmth and the experience a burst of sound when the box is opened.

### Swell Muffle (New Method)[iii]

These settings reduce the brightness of the sound, much like turning down the treble on an amplifier or with an equalizer. These settings should be used *only* if there are no frequency modifications in the soundfont. Notes with frequency modifications will have their frequencies reduced at a higher rate than those with no modifications.

For each instrument in the sf2 file:
- the filter frequency 17000Hz is specified in the global column,
- still in the global column, the following modulator is used

CC-016 (linear descending), no controller (linear ascending) -4200, destination filter cut-off




This modulator can be combined with the modulators for tremulants, listed below.

Continuous filter in jOrgan:

| | |
|---|---|
| Engaging | set 176, set 11, set value \| mult 0.5 \| add 0.5 \| mult volume 127 |
| Engaging | set 176, set 16, set value \| mult 100 |

In the second "Engaging" command above, an adjustable command can be set:

| | |
|---|---|
| Engaging | set 176, set 16, set value \| mult 0.85 \| add 0.15 \| mult volume 100 |

The setting of “mult 0.85 | add 0.15” gives 85% of the effect. The “add” command should be 1.0 minus the mult command.

Swell Muffle (New Method) was explained to me by Davy Triponney of Polyphone.

## Swell Muffle (Non-Frequency Psycho-Acoustic Method)

If you use a lot of high frequency filters in your soundfont and don’t want remove them, this method will give you a different swell muffle effect. I call it “psycho-acoustic” because it depends on the way your brain interprets the volume changes of the different ranks.

Create two continuous filters. Name one “Swell.master.expression.” Reference all 16’, 8’ and 4’ flue ranks (except for bright strings) to it. Give it this continuous message:

| | |
|---|---|
| Engaging | set 176, set 11, set value \| mult 0.5 \| add 0.5 \| mult volume 127 |

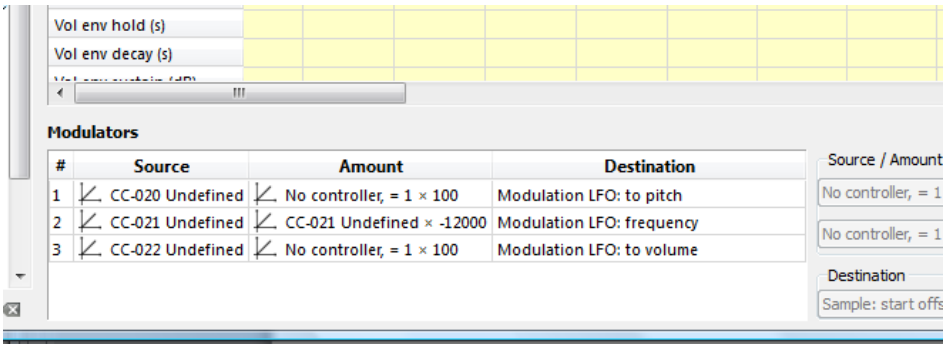
Name the second “Swell.reeds and upper.expression.” Reference all reeds, bright strings and all flues above 4’ including mixtures to it. Give it this continuous message:

| | |
|---|---|
| Engaging | set 176, set 11, set value \| mult 0.6 \| add 0.4 \| mult volume 127 |

Reference “Swell.master.expression” to the connector. Use the new (jOrgan 3.20) “synchronizing” to synchronize both continuous filters. When the expression pedal is down, reeds and upper will have the volume lower than the16’, 8’ and 4’ flues, giving the illusion of the higher frequencies being muffled when the swell box is closed. When the swell pedal is opened, the reeds and upper work will seem to rise in volume faster than the 8’ and 4’ flues.

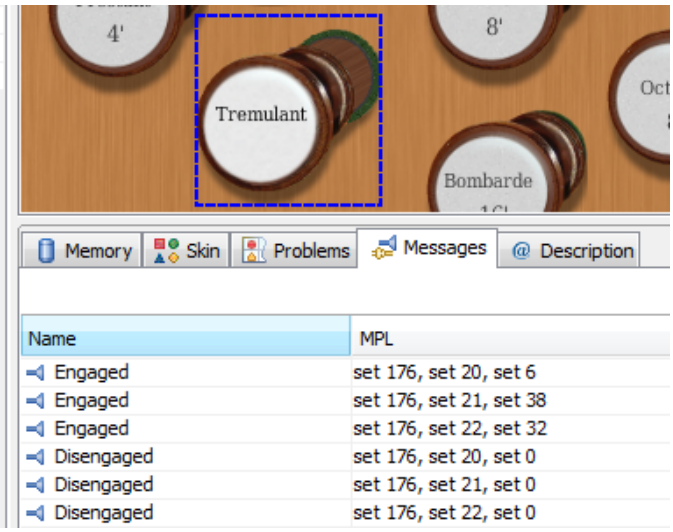
# Tremulant Settings (Soundfont/Polyphone and jOrgan disposition)

First, the CC controllers must be enabled/installed on the instrument level in the soundfont.




View of Soundfont instrument modulators in Polyphone

Then in the disposition, make a switch filter with messages for CC20 to CC22




View of MIDI commands in jOrgan for the soundfont modulators

Use the charts below to determine the “Engaged” settings.

## Tremulant Setting Charts:

| Pitch Variance (Cents) | CC 20 (range 0-127) |
|---|---|
| 100 | 127 |
| 50 | 64 |
| 25 | 32 |

The formula for pitch variance is multiply pitch in cents by 1.27 to get the CC20 setting.

| Frequency (Hz) | CC 21 (range 0-127) |
|---|---|
| 7.00 | 19 |
| 6.88 | 20 |
| 6.76 | 21 |
| 6.64 | 22 |
| 6.51 | 23 |
| 6.38 | 24 |
| 6.25 | 25 |
| 6.11 | 26 |
| 5.98 | 27 |
| 5.84 | 28 |
| 5.70 | 29 |
| 5.55 | 30 |
| 5.41 | 31 |
| 5.27 | 32 |
| 5.12 | 33 |
| 4.97 | 34 |
| 4.83 | 35 |
| 4.68 | 36 |
| 4.54 | 37 |
| 4.40 | 38 |
| 4.25 | 39 |
| 4.11 | 40 |
| 3.97 | 41 |
| 3.83 | 42 |
| 3.69 | 43 |
| 3.56 | 44 |

The formula to convert CC 21 value to frequency:

Set ***20*** --> Value = (***20***/127)*(***20***/127)*(-12000) = ***-298*** --> 2^(***-298***/1200)*8.176 = 6.88 Hz.

| Volume Variance amount of total volume | CC 22 (range 0-127) |
|---|---|
| 0.05 | 10 |
| 0.10 | 20 |
| 0.20 | 30 |
| 0.30 | 40 |
| 0.45 | 50 |
| 0.45 | 60 |
| 0.48 | 70 |

The formula for volume is multiply volume variance by 127 to get the CC22 setting.

## Chime / Percussion

This was discovered by accident in an early attempt to find MIDI commands for swell muffle. The effect is actually cyclical. The tone plays and decays and will fade back in if you hold it long enough. For most notes in normal play, it will serve well for a chime or percussion effect.

Make a switch filter. Reference all the ranks you want the chime/percussion effect applied to. Give it these MIDI messages.

| | |
|---|---|
| Engaged | set 176, set 99, set 120 |
| Engaged | set 176, set 98, set 22 |
| Engaged | set 176, set 6, set 50 |
| Engaged | set 176, set 99, set 120 |
| Engaged | set 176, set 98, set 13 |
| Engaged | set 176, set 6, set 50 |
| Disengaged | set 176, set 99, set 120 |
| Disengaged | set 176, set 98, set 22 |
| Disengaged | set 176, set 6, set 0 |
| Disengaged | set 176, set 99, set 120 |
| Disengaged | set 176, set 98, set 13 |
| Disengaged | set 176, set 6, set 0 |

## Virtual Organ Stereo Theory (Soundfont/Polyphone)

There are several ways to do stereo effects and different goals for them depending on the organ and individual taste.

### True Stereo

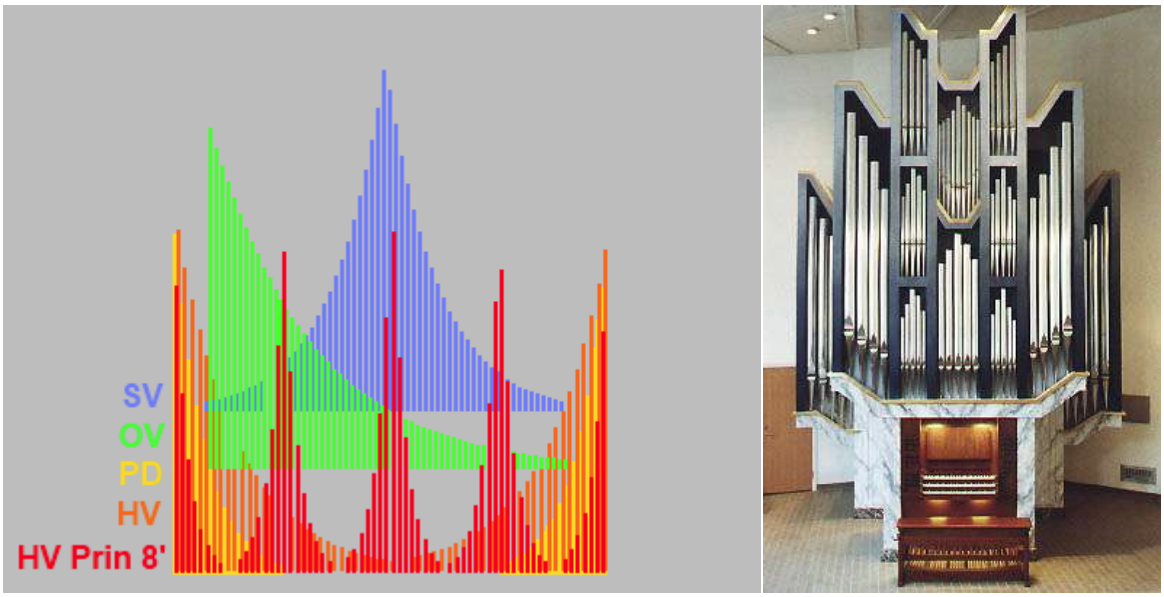
Samples are recorded in stereo and reproduced in stereo. This is the most accurate reproduction of stereo effect, especially if reverb tails are also recorded.

### Chambers

Theatre organs were arranged by chambers, so also were some divisions of American Classics (and American pre-Classic "Let's put the pipes in this closet over here.")

### Pipe Chest Layout and “Werkprinzip”

I've been using this for a long time, and Polyphone makes it even easier. (It's also easy to change pipe chest layout in a matter of seconds.) My use of pipe chest layout is done with the idea of "Werkprinzip." (See photo and references below.) I set all Hauptwerk or Great ranks at a medium-wide (60%) hollow (or "M") configuration (and then arrange the façade pipes approximately the way they are if a photograph of the organ is available). Swell or Oberwerk ranks at a medium-wide (60%) spike (or "A") configuration. Positiv at a narrower (45%) low to high configuration or hollow, again depending on the organ I’m trying to make. The pedal division is arranged either in a spike configuration or hard left and hard right, depending on the type of organ I'm trying to replicate.

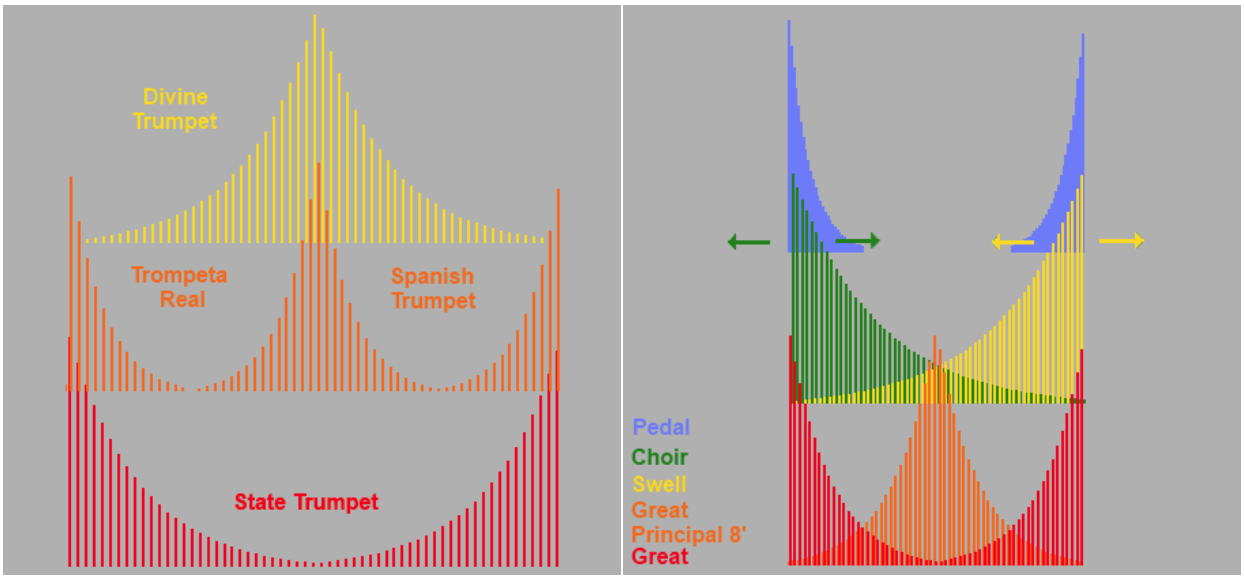



**The Pitea organ's stereo spread. Note the HV's hollow stereo spread, with the HV Principal 8's different façade spread to approximate what is seen in the photograph. Pedal division is a wide hollow spread to have more of a hard left and hard right effect.**

When played in a reverb environment, everything gets blended. In a real organ, the pipes' arrangement isn't as clear because the sounds get blended in the organ case, so my use of "pipe chest layout" may give more distinct left-right directionality than the real thing. A narrower spread can help blend. One of my reasons for using pipe chest layout is give the sound presence, something that was lacking when electronic organs had single speakers or had two speakers, flutes and principals came out of one, reeds and strings out of the other.

If you use mono samples, some panning will have to be done. Reverb effects do impart some stereo presence, too.

The ACO has Swell as high to low and Choir low to high, just to be different, plus these divisions can be moved left, right, center, as desired with pan switch filters using midi pan commands




The ACO's State Trumpet voices are spread extra wide to give a better "en chamade" effect. The types of stereo spread are also based on the types of organ ranks they are designed to emulate.

Info on "Werkprinzip"
http://www.die-orgelseite.de/funktionsweise_e.htm
http://faculty.bsc.edu/jhcook/orghist/history/hist033.htm

# ENDNOTES: Older Methods for Some Effects

## [i] Random Motion / Wind Destabilization (Old Method)

In the American Classic Organ I made a "Wind Destabilizer." Twenty switch filters referenced to all ranks. Odd numbered switch filters had this message:

| | |
|---|---|
| Engaged | set 176, set 101, set 0 |
| Engaged | set 176, set 100, set 1 |
| Engaged | set 176, set 6, set 64 |

Even numbered switch filters randomly referenced "set 65" "set 63," or "set 62" in the third "set 176, set 6, set *N*" message. Odd numbered switch filters received a longer random duration between 121 and 540 msec. Even numbered received a shorter duration between 25 and 50 msec. Random values were generated through "random.org." All switch filters were put in a regulator and advanced and recycled using synchronizers.

## [ii] Voice Articulation / Flexible Wind (Old Method)

Voice Articulation simulates the slight variance in pitch that is experienced when other passing notes are played. The phenomenon is often called "Flexible wind" (See article on "Flexible Wind" here).

To simulate this, make a switch filter with the message

| | |
|---|---|
| Engaged | set 176, set 101, set 0 |
| Engaged | set 176, set 100, set 1 |
| Engaged | set 176, set 6, set 61 |
| Disengaged | set 176, set 101, set 0 |
| Disengaged | set 176, set 100, set 1 |
| Disengaged | set 176, set 6, set 64 |

…with a duration of 25 (greater if more of an effect is desired), referenced to all ranks. (Ranks below 8' can be omitted because the effect will not be noticeable at lower pitches.)

Create switch and call it "Flexible Wind Input Switch" and give it an Activate message

| | |
|---|---|
| Activate | greaterEqual 144 \| lessEqual 159, lessEqual 96 \| greaterEqual 36, greater 5 |

…Reference it to the jOrgan MIDI merger with a special connector. This will respond to all activity from all MIDI devices referenced to jOrgan MIDI merger. Give the Input Switch the same duration as the switch filter.

Make a synchronizer and name it "Flexible Wind" and reference the Input Switch and the switch filter. Set the synchronizer "When activated: ACTIVATE" "When deactivated: IGNORE." Put the synchronizer on the console, and the Flexible wind simulation can be turned on or off.

Both effects described above do more than give a momentary pitch variance. They also give a change in phase of the sound wave.

## [iii] Swell Muffle (Older Method)

Create a continuous filter. Give it these continuous messages:

| | |
|---|---|
| Engaging | set 176, set 11, set value \| mult 0.5 \| add 0.5 \| mult volume 127 |
| Engaging | set 176, set 99, set 120 |
| Engaging | set 176, set 98, set 8 |
| Engaging | set 176, set 6, set value \| mult 0.33 \| add 0.66 \| mult volume 80 |

Like the new method, these settings should be used *only* if there are no frequency modifications in the soundfont. Notes with frequency modifications will have their frequencies reduced at a higher rate than those with no modifications.