Thanks for grabbing a TXo+ Upgrade – the upgrade for those with discerning tastes in output expanders. This kit includes a hand-modified Teensy 3.6 and a bunch of capacitors that you don’t really need. No worries on that last part; all will be explained below.

**What to Expect**

When running on the Teensy 3.6, the TXo firmware does a few new things:

* Improved Sampling Rate - increased to 25kHz from the TXo’s 15.625kHz
* Improved Quality when Combining Features with Oscillation - the stock TXo disables interpolation if more than one advanced feature is used at a time for a CV output (envelopes, wave morphing, pitch slew, etc). The TXo+ always uses interpolation which increases the accuracy and lowers distortion.
* Enhanced sawtooth and square waves using the PolyBlep technique in order to reduce aliasing.
* More Morphing Wavetables - the TXo+ has 327 different waveforms on board (up from the TXo’s 45). Values range between 0 and 32699. Every 100 you get another “pure” waveform. 32600 should be random noise.

The commands are the same between the TXo and the TXo+. The only difference is the TO.OSC.WAVE as mentioned above. You don’t have to learn anything else if you are familiar with your TXo. ☺

Now, here is the important bit: your TXo will still alias like crazy when used as an oscillator without additional filtration. It was designed as a CV device and only lightly filters the output. You might like the sound this way. I do.

You can clean things up with the right additional filtration (at 12.5k). This primarily will benefit the primitives (sine, square, saw, and triangle); extended waveforms will still alias as the expander doesn’t have the horsepower to oversample.

**How to Install the Upgrade**

There are two ways for you to do this. The reasonable way and the ridiculous way. The ridiculous way, while being ridiculous, includes the steps of the reasonable way. So, as with all things, let’s start reasonable and then get ridiculous.

Reasonable Install Steps

1. Carefully extract your TXo from your case.
2. Make sure you are grounded and not full of static electricity. (Good idea to banish the cat until you are done.)
3. Grip the Teensy processor on the back and delicately lift it out of its socket with even force on both sides. You might need to rock it a bit – just don’t do too much of that or you will bend the pins.
4. Remove the Teensy 3.6 with attached TeensyHelper from the antistatic bag.
5. Insert the old Teensy 3.2 into the empty antistatic bag and seal it.
6. Carefully insert the Teensy 3.6 into headers on the TXo body with the same orientation as the previous Teensy. (USB socket facing up and SD card facing down relative to the module.)
7. Make sure everything is seated properly and happy – including the various boards of your TXo.
8. Connect up your module to power and i2c and run a test to see if you get blinking lights and signal. (See “troubleshooting” below if you have problems.)
9. Reinstall your module.
10. Party.

Ridiculous Install Steps

This part is stupid. Best you ignore it.

We’ve included four capacitors with your upgrade. Trust us when we say that you don’t need them. Like, not at all. You won’t hear a difference. You won’t see a difference. You will more likely bork your TXo if you try to swap them out.

Why did we include them? We are asking ourselves the same question.

Maybe it was to torture you? We know that they would bug you. Disappoint you that they aren’t installed. That having them in your studio would be a constant reminder of incompleteness. A reminder of how your TXo+ is less than other TXo+ in the world.

Nah. They really don’t matter.

We included them for the sake of completeness – which for some reason is important to us. What they do is raise the cutoff point of the 1-pole filter on the TXo’s output so that it matches the new sampling rate. How much? Not much. Somewhere between 4-5 kHz.

Now, when you hear filter you are most likely thinking **F**ilter. That’s not what we are talking about here. A 1-pole filter is a wimpy thing with a super gradual cutoff. It gets beat up after school. It has self-esteem problems. This is why we recommend more filtration if you want to get pure tones out of your TXo+.

We’ve included six capacitors that swap out for C102, C2, C3, and C4 on the TXo. Does your head hurt now? Think we can’t count? Come on; we included two extra just in case you sneeze while futzing when them (even though we told you not to).

Anyway, you can find all of the details on the github page for the module. We’re not including it here in order to avoid tempting you to try to swap them out – because you don’t need to.

Like, don’t. Just let it be.

You really don’t need them.

**Troubleshooting**

Your upgrade was installed and tested at our factory and should be in great shape. That is what the little orange dot means on the SD card.

Ok. it isn’t a “factory”, per se. It is a messy-as-hell guest bedroom that has never accommodated a guest - outside of the four-legged and furry kind.

Regardless, it was working when we sent it. The most common problem we have seen is with the machined headers that connect the two units. Sometimes they are so perfectly aligned that a pin or two makes poor contact. This will manifest itself in no CV (all values at -10), a trigger that doesn’t fire, an LED or two that doesn’t light up, or an unresponsive module.

The way to correct this is to provide a *very slight* bend to pins, alternating the direction (in vs out) until everything is happy. They are delicate, so you have to be extremely careful when doing this. Do them one at a time and test that you can still seat the processor.

Any other problems? Give a shout on lines (https://llllllll.co/) in the TELEX thread.

GOOD LUCK!!

b