Thank you for your purchase of the Hakai Labs Turbocharger Eurorack Module! This guide will give you a good overview of the module and its functionality, allowing you to explore deeper on your own.

Don't bother RTFM'ing this thing, just plug the module in and start playing with it. 😊

What is Turbocharger?

Turbocharger is an idea that I (Scott Danesi) have had for some time now. After watching a presentation by Jon Sonnenberg (artoftravelogue.blogspot.com) back in the day at one of the early Knobcon conventions in Chicago on Wave Replacement Synthesis, I thought, I could do that in one module but make it crazier. So, what started out as a simple "Turbo" gate for the NT Controller module, now turned into this monstrosity.

Turbocharger at its core, is just a simple super high-speed switch (not a VCA) between 2 inputs. This sounds boring, but the switch is run by a CMOS switch IC capable of switching at extremely high speeds. This, paired with its internal oscillator, with PWM controls, makes for some fun experimentation. The best part is you don't even have to use the internal oscillator. There is an external clock input that you can patch in your own pulse wave to control the switch.

Now where Turbocharger gets a bit crazy is when you mess with the Detonation knob. This knob will start injecting signals into your clock signal controlling the main switch. With the detonation knob on the left half of the center position, it will detect and inject clock division pulses (which will not be exact on purpose). When set to more than halfway, it will start injecting whatever it feels like at the time. This could be noise, oscillations, and other crap. The higher the knob, the crazier and more frequent the signals. The position of the RPM and AFR knobs also will change what the detonation is doing.

Now, what is fun is that the detonation corruption will loop itself if a gate signal is applied. For instance, if you have a 4 to the floor kick with a 16th note pulse on the gate input, it will start making repetitive glitches at divisions dictated by the position of the AFR knob. This looping creates some awesome techno glitches. This is highly experimental and will never be consistent, so use at your own risk.

Turbocharger Key Terms

Below are some key terms and definitions that will be used throughout this documentation.

AFR – The pulse width of the internal (RPM) oscillator/clock. This is a reference to the air/fuel ratio of a high-performance car engine.

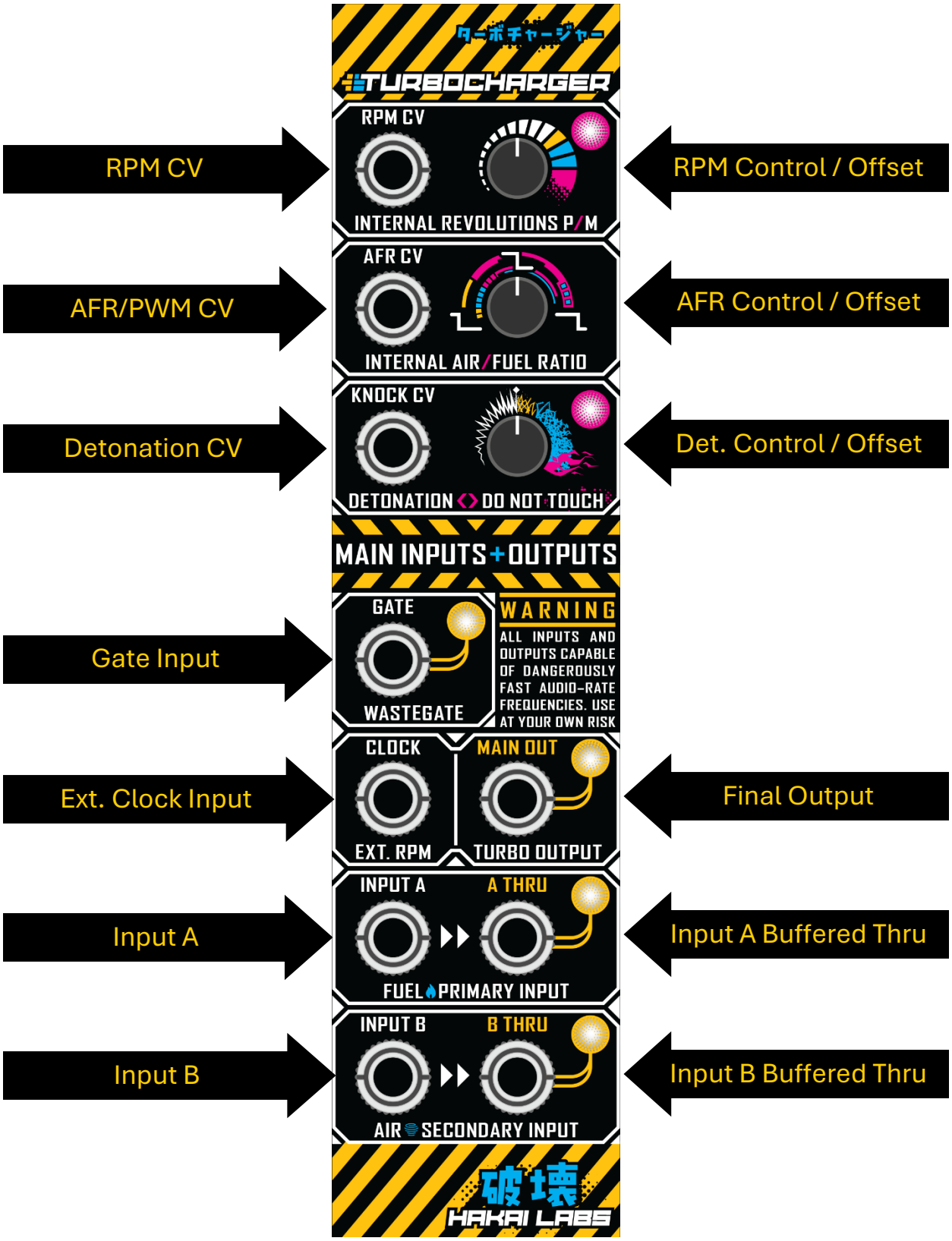
Detonation / Knock – The injection of signals outside of the consistent internal or external clock (RPM) source. This is a reference to when a cylinder in a high-performance car engine combusts before it is supposed to, usually causing damage to the engine.

External RPM – A clock signal use to override the internal oscillator of the unit.

RPM – The oscillation/clock of the main CMOS switch between input A and Input B. A nod to the revolutions per minute of a car engine.

Wastegate – A final gate on the main output. A reference to a part of a high-performance car engine that will dump the turbo exhaust pressure of the forced induction system to cut off or cut down the boost.

Front Panel / Inputs / Outputs / Controls



Input A and B (Fuel and Air Inputs)

Input A and B are the main signal inputs into turbocharger. These 2 inputs can range anywhere from -12v to +12v. These signals will be buffered and passed through to the Input A and B outputs untouched. These 2 inputs are routed through the main CMOS switch in the unit which then sends the chosen signal to the Main Output. This will alternate between Input A and Input B based on the speed of the RPM.

If nothing is plugged into input A, it will be normalized to 5vdc. If nothing is plugged into input B, it will be normalized to GND / 0v. This is handy as it will work as a nice 5v gate signal on the output without having any external input.

Voltage Range: -12v to +12v

RPM CV Input and RPM Control / Offset

The RPM is what the internal oscillator speed that controls the main CMOS switch between input A and Input B is referenced as on this module. The internal oscillator runs when there is nothing plugged into the External RPM clock input. You can use the potentiometer to set the speed of the internal oscillator (RPM).

The speed of the RPM can also be controlled by the RPM CV Input. This input accepts a signal from -5v to +5v and is essentially controlling the position of the RPM Control potentiometer. When a CV is inserted into the RPM CV Input, the RPM control knob will now act as an offset for the value of the CV. This is not an attenuation, rather an offset.

Voltage Range: -5v to +5v

AFR Control / Offset and AFR CV Input

The ARF control knob will dictate the pulse width of the internal RPM oscillator. At 12'oclock, the PWM signal will be at a 50% distribution of Input A and Input B.

This Pulse Width (AFR) can also be controlled by the AFR CV Input. This input accepts a signal from -5v to +5v and is essentially controlling the position of the AFR Control potentiometer. When a CV is inserted into the AFR CV Input, the AFR control knob will now act as an offset for the value of the CV. This is not an attenuation, rather an offset.

Voltage Range: -5v to +5v

Gate (Wastegate) Input

The Gate (Wastegate) Input is yet another high-speed CMOS switch on the main out. This switch will go between whatever is coming out of the main output and 0v. Keep in mind this is NOT a VCA, this is a switch. When the input is high (> ~2.5v) the Main Output will be active; when the gate input is low, it will make the Main Output 0v / GND.

This Gate Input also has some interesting interactions with the internal Detonation Logic, see the Detonation section below.

When there is nothing plugged into this input, it will normalize to 5v holding the main output open.

Voltage Range: 0v to +5v

External Clock Input (External RPM)

The External Clock Input is a direct override of the internal oscillator that controls the main CMOS switch between input A and Input B. This means you can take over this signal externally and create all sorts of strange scenarios.

Voltage Range: 0v to +5v

Detonation (Knock) Control / Offset and Detonation (Knock) CV Input

Now here is where this module gets crazy. Detonation will inject signals into the clock signal for Input A and Input B. This detonation logic is controlled by a microcontroller that is constantly reading the current state of the module to make decisions on what it should do.

At the far-left position about 7:00 on the Detonation Control Potentiometer, the detonation logic will be completely disabled. This means you have full control over the switches int eh module without any extra garbage being injected into your clock signal.

To the left of 12:00 are glitchy clock divisions based on the internal or external RPM signal. These are not perfect and will shift slightly due to some random logic I programmed into the microcontroller to give it a bit of life. These clock divisions will disable if the RPM is too high for the microcontroller to read.

Past 12:00 and you are going to start getting random junk thrown into the clock (RPM) signal just as you would if you were getting detonation or knock on a car engine when doing high performance tuning. These glitches and junk will lock into a loop when using the gate input. The father right this knob is turned the denser and crazier the glitches and random oscillations become. These glitches are also affected by the RPM potentiometer if you do not like what it is doing. The glitch looping can be adjusted by tweaking the AFR Potentiometer as well. Experimentation is key here.

Analog Signal Path