



ORNAMENT-8
ORGANISMIC SEQUENCER

USER
MANUAL



GENERAL REVIEW

ORNAMENT-8 is an analog synthesizer of behavior for creating complex rhythmic patterns and control signals. Since it inherits and further develops the principles laid down in the LYRA-8 organismic synthesizer and the PULSAR-23 organismic drum machine, we called it the "organismic sequencer". The ORNAMENT is radically different from traditional sequencers and is based on entirely different principles.

A regular music sequencer tends to produce user-defined sequences of musical events (notes and control parameters) that play at a given speed (tempo). Different sequencers differ mainly in how this sequence of musical events is set and what modifications are possible. But even in the most advanced and complex sequencers, there is still some memory containing the given events which are reproduced at the given speed. This memory can contain many options and patterns with a flexible system for switching between them and have various playback algorithms, but the basic principle remains unchanged.

The fundamental difference of the ORNAMENT is that it has no clock generator and lacks the very concept of tempo (playback speed). There is no memory that stores musical events and there are no global control elements. Instead, we have a fully horizontal structure consisting of 8 identical and equal cells. Each cell is a controlled delay line that receives a pulse, which it holds for a certain time before it passes the pulse on. Each cell has two pulse transmission modes, several control inputs and several outputs. By commutating cells (see below for definition) in different ways, you create a dynamic structure in which pulses that wander in the system are transmitted, added and subtracted, generating behavior that you can transform into various musical events and controlling voltages.

We can say that the ORNAMENT is an electronic micro-model of an anarchist society. When you experiment with this system you can observe and explore the process of life arising in incredible structures which have no discernable order other than the direct relations between its equal members.

There is no Holy Book in which the events of the future are recorded. There is only the ever-present and continually arising "now" that flows and develops from moment to moment, according to the relationships established within the system.

The ORNAMENT is similar to an organism where an ensemble of interacting organs covered by various connections, generates the resulting behavior, which is a dynamic sum of interactions. This behavior is not stored in any memory and does not follow directly from the properties of individual organs, but is a meta-property of the system as a whole.

There is no main organ in the body, although for some time in some circumstances one of the organs may turn out to be the leader and determine the behavior of the system. Similarly, in ORNAMENT, in some patches, individual cells can have a dominant influence on the system, but this will always be a property of the patch, and not a unique property of the cell itself.

Depending on the switching scheme and settings, the ORNAMENT can generate both stable, strictly repeating oscillations, and very complex, time-evolving sequences close to pseudo-chaotic. The 100 percent analog nature of the ORNAMENT, sensitive to environmental changes and the saturated life of the microworld, introduces an element of real chaos and unpredictability into its behavior, which is especially evident when the system is not stable and has many quasi-stable states between which it can switch from the slightest changes in the flow of pulses. In the extreme case, the ORNAMENT is able to generate entire compositions with specific dramaturgy, pauses and developed structure.

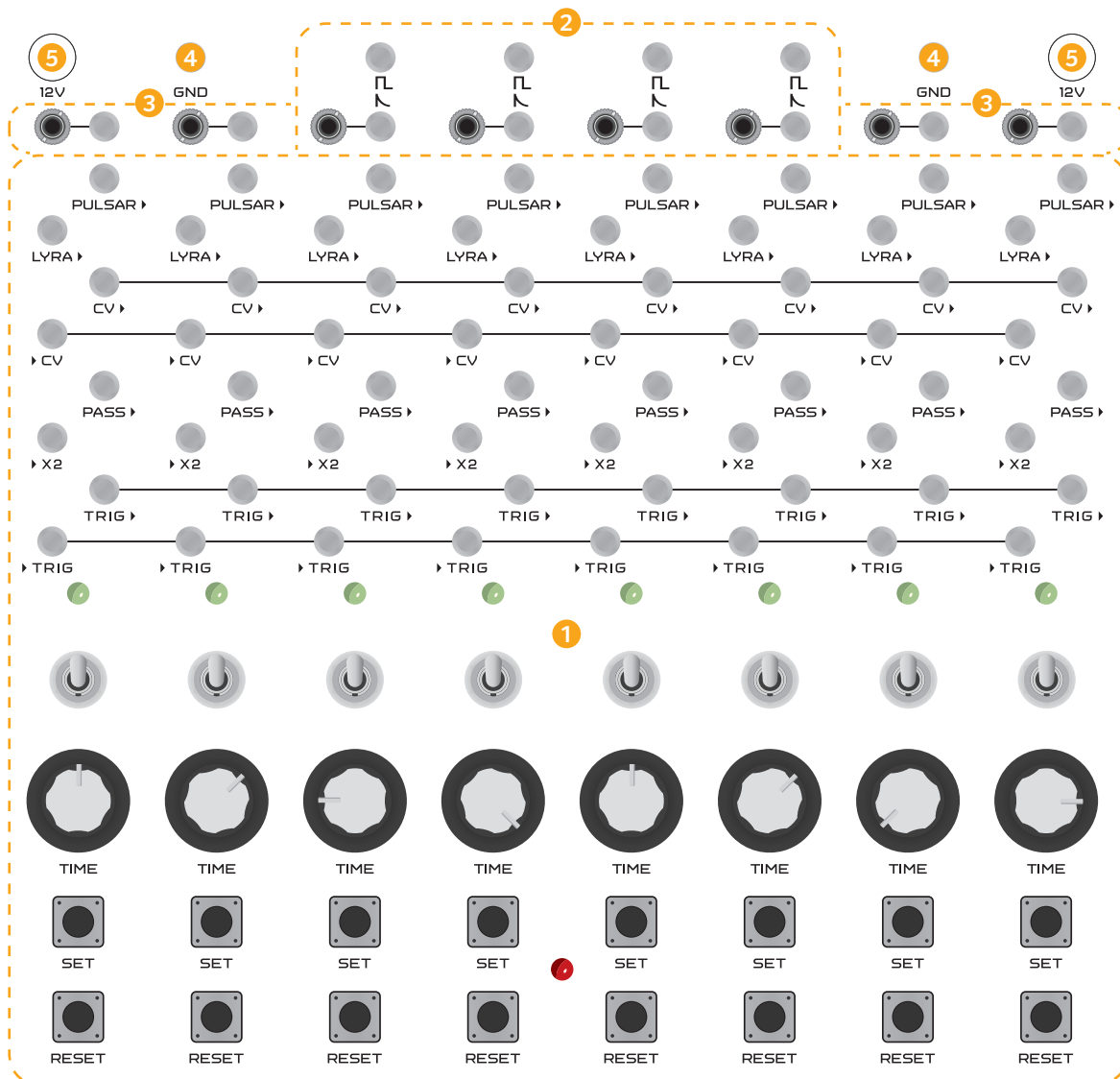
The identical nature of the cells makes it possible to connect multiple ORNAMENTS together, creating generative structures of 16, 32, etc. cells and, accordingly, more complex and diverse behavior.

The external CV control feature allows external devices to control the behavior of the ORNAMENT. We achieved interesting self-developing compositions when we combined PULSAR•23 and ORNAMENT with many connections, where both ORNAMENT controlled PULSAR and PULSAR influenced ORNAMENT.

In other words, the ORNAMENT offers vast possibilities of experimentation in the field of generative music. It's a fully analog device, essentially an analog computer. On a more philosophical level, ORNAMENT is an opportunity to learn about the fundamental laws that govern our life, society and history by experimenting with a small device the size of a box of chocolates.

The ORNAMENT works wonderfully with LYRA•8 and PULSAR•23, adding a new dimension to them, and it can also control and manage Eurorack modules as well as anything that can accept CV.

DETAILED DESCRIPTION OF ORNAMENT AND ITS OPERATION



The ORNAMENT includes:

- 1 Eight identical cells, which are controlled delay lines.
- 2 Four pulse converters combined with 3.5mm contact-minijack adapters.
- 3 Four 3.5mm contact-minijack adapters.
- 4 Two ground contacts for connecting to the ground of the connected device.
- 5 Two +12v power sockets connected in parallel for powering external devices.

ORNAMENT is a fully modular sequencer and its various blocks do not have any internal connections. In order for any behavior to appear in the system, the user needs to create a patch by connecting the inputs and outputs of the cells. The behavior arises from the fact that the system responds to events that occur within it, and thereby generates future events that will again, in their turn, find a response in the system.

The result of this behavior, which can be used to control various musical instruments, is the voltage appearing at the outputs of the cells **CV**, **LYRA**, **PULSAR**.

DELAY CELL INTERFACE





All inputs are marked with a ▶ before the name of the input (▶TRIG, ▶X2, ▶CV). All outputs are marked with a ▶ after the name of the output (TRIG▶, PASS▶, CV▶, LYRA▶, PULSAR▶)



The interface of each delay cell consists of the following elements:

- 1 **RESET** button – puts the cell in an inactive state.
- 2 **SET** button – puts the cell in the active state.
- 3 **TIME** knob – determines the time during which the cell is in the active state, which is also the transmission speed of the trigger pulse and the slew rate of the voltage output **CV▶**. When rotating clockwise, the cell activity time decreases and the transmission speed of the trigger pulse increases. Slew rate means change of voltage per unit of time.
- 4 Output signal phase toggle switch.
Upper position – normal operation or positive mode.
 If the cell is inactive: **CV▶** = 0v, **LYRA▶** = open, **PULSAR▶** = 0v.
 If the cell is active: **CV▶** = increasing voltage 0–10v, **LYRA▶** – closed, **PULSAR▶** – 10v.
Lower position – all outputs are inverted.
 If the cell is inactive: **CV▶** = 10v, **LYRA▶** = closed, **PULSAR▶** = 10v.
 If the cell is active: **CV▶** = decreasing voltage 10–0v, **LYRA▶** – open, **PULSAR▶** – 0v.
Middle position – all outputs are disabled.
 In any state of the cell: **CV▶** = 0v, **LYRA▶** = open, **PULSAR▶** = 0v.

 The position of the switch does not affect the operation mode of the ▶TRIG input and TRIG▶ output
 Actual voltage at the outputs of the cells may slightly vary from the indicated ones (+\ - 10%).

5 Cell activity indicator. Connected to **PULSAR▶** output. With switch 4 in upper position, a lit indicator indicates an active cell. With switch 4 in lower position, a lit indicator indicates an inactive cell.

6 Input contact ▶TRIG. Connection to the ground of this contact (or negative pulse) activates the cell.

7 Output contact TRIG▶. At the moment of transition to an inactive state, a short negative pulse appears at this output.

8 Input contact ▶X2. Applying a positive voltage of more than 1 volt to this input doubles the capacitance of the storage capacitor of the delay line, which is equivalent to multiplying the **TIME** parameter by two (doubling the time of activity).

9 Output contact PASS▶. If a new trigger pulse arrives at an already active cell, then it is transmitted to the output PASS▶. This passes the given pulse to the next cell connected to the PASS▶ output, instead of the pulse disappearing.

10 Input contact **▶CV**. The voltage at this pin controls the **TIME** pulse rate. Baud rate = voltage at **▶CV** x **TIME** knob position.

An unconnected pin has a voltage of 3 volts.

11 Output contact **CV▶**. With the phase switch in upper position and the cell activated, the output voltage increases from 0 to 10 volts. With the phase switch in lower position and the cell activated, the voltage at the contact drops from 10 volts to 0.

This output is designed to control the PULSAR, LYRA and any equipment that can receive a CV signal from 0 to 10 volts.

12 Output contact **LYRA▶**. While the cell is active, this contact is connected to ground. When the cell is not active, the contact is not connected to anything. With the phase switch in lower position, the behavior of the contact is inverted.

These outputs are designed to connect the ORNAMENT to the LYRA•8. Use the sensor overlay adapter (sold separately) to connect to LYRA. Connect **LYRA▶** outputs to adapter pins 1–8. Connect one of the pins of the adapter **GND** to one of the pins of the **GND** of ORNAMENT. In ORNAMENT and adapter both **GND** contacts are ground. On the adapter, they are connected to the lower LYRA sensors (bottom row) and the instrument ground. In ORNAMENT, both **GND** pins are connected to the ground of the instrument.

The **LYRA▶** contact, connected through the adapter to the LYRA, at the moment of activation of the cell, connects the sensor to the ground, simulating a finger touching LYRA's sensor, and starts this voice of the instrument, thus allowing the ORNAMENT to control the LYRA.

13 Output contact **PULSAR▶**. In an active cell, this contact will have an output voltage of 10 volts. In an inactive cell, the output voltage is 0 volts. With the phase switch in lower position, the output behavior is inverted.

This output is designed to control the PULSAR and any equipment that can receive a CV signal from 0 to 10 volts.

HOW PULSE DELAY CELLS WORK

Each of the eight identical cells consists of a capacitor and a circuit that charges and discharges the capacitor. In the inactive state, the capacitor is discharged, the outputs **CV▶** and **PULSAR▶** have a voltage of 0, and the output **LYRA▶** is open. In order to activate the cell, it is necessary to supply a negative trigger pulse to the input **TRIG▶** (briefly connect it to the ground or apply a voltage of less than 2.5 volts). The trigger pulse turns on the charge circuit of the capacitor and it begins to charge. The charge rate of the capacitor depends on the input voltage **▶CV** and the position of the **TIME** knob. This relationship can be expressed by the following formula:

Charge rate = voltage at **▶CV** x position of the **TIME** knob.

Thus, the higher the input voltage of **▶CV** and the closer the position of the **TIME** knob is to the maximum, the higher the charge rate of the capacitor. Or, in other words, the pulse transmission speed is higher and, accordingly, the pulse delay time or cell activity time is smaller.

In the unconnected state, the input **▶CV** has a voltage of 3 volts, and the **TIME** knob works referenced to it if nothing is connected to the input.

At the moment when the voltage on the capacitor reaches +10 volts, it instantly discharges and the cell goes into an inactive state. At the moment of transition to an inactive state, a short negative pulse is generated at the output **TRIG▶**, which can be used to start / activate any other cell, except for the cell that generated the pulse.

From the point of view of classical circuitry, each cell is a monostable multivibrator or a time

relay with a controlled duration of stay in the active state, and some additional functions which will be described later.

Let's compare ORNAMENT to a mechanical system in which pulses are transmitted, such as in billiards. A billiard ball rolls in the free state for a certain amount of time until it hits another ball, and transfers the pulse to that ball. In ORNAMENT, each cell is like a billiard ball, and the capacitor charge time is the time of free movement of the ball from the moment a pulse was transmitted to it until it encounters the next ball, transmitting the pulse to it. Looking at the ORNAMENT as a system in which pulses are transmitted with a certain delay will help to master it faster and more fully, therefore we will return to this analogy in further explanations.

What if the trigger pulse arrives at an already active cell?

To prevent such a pulse being "wasted in vain" we added an additional output **PASS▶**, to which this pulse is transmitted if the cell is already active. Aside from saving the pulse, this output also allows you to branch ORNAMENT behavior algorithms by sending pulses to the **TRIG▶** or **PASS▶** outputs, depending on whether these cells are active or not.

In order to provide an additional option for discrete control of the cell delay time, we added an input **▶X2**. When a voltage is applied to it of more than 1 volt, it connects an additional capacitor of the same capacity in parallel with the main capacitor of the cell. Thus, the charge time and, accordingly, the cell activity and pulse delay times are doubled.

This function has one feature that makes its effect on the operation of the ORNAMENT more complex: at the time of removing the voltage from **▶X2** and disconnecting the additional capacitor from the main capacitor, some voltage may remain on it if the disconnection occurred during the phase of cell activity. At the time of the next supply of voltage to **▶X2** and the connection of an additional capacitor, the charges of both capacitors will equalize and will be equal to the sum of their charges divided by two. Thus, the cell activity time may be less than **TIME**x2. We can say that the function X2 remembers the state of the cell at the last moment of the function's activity.

The result of the cell activity can be obtained at its three outputs:


CV▶ output – the voltage on it is equal to the voltage on the capacitor and can vary from 0 to 10 volts.

LYRA▶ output – during cell activity is connected to the ground (GND pin).

PULSAR▶ output – in the active state, the output voltage is 10 volts, in the inactive state, the output is 0 volts.

The phase switch allows you to invert the state of the cell outputs (lower position) or turn them off completely and make the cell in the musical sense a pause generator (middle position).

The **SET** button activates the cell, as does a negative pulse at the **TRIG▶** input. These buttons are used for bringing the ORNAMENT patch you created into motion. Pressing them is the equivalent of cue strikes on selected billiard balls in our mechanical model. Thus, by using the **SET** buttons, you can add pulses to the ORNAMENT system.

 While you hold the SET button, the cell will be active, even if the capacitor is already fully charged (i.e longer than set by the TIME knob).

The **RESET** button puts the cell in an inactive state from any phase of activity. Using these buttons you can reduce the number of pulses in the ORNAMENT system.

PATCHING

Commutation of trigger pulses:

Since the output trigger pulse cannot be transferred back to the input of the same cell, at least two cells must be connected in order for the pulses to continually circulate. Let's examine the principles and techniques of commutation of trigger pulses.

The pulse triggering the cell is a short or long connection of the input **▶TRIG** to ground, or when a voltage of less than 2.5 volts is applied to it. The trigger pulse is negative, meaning the voltage transition goes from high to low.

TRIG inputs and outputs, as well as the **PASS▶** output, are special, since it is through them that trigger pulses are transmitted and circulate. These inputs and outputs have their own format and, in principle, are not intended to be connected to anything else or externally. Of course, with sufficient understanding of their underlying working principles, such connections are possible. However, for all but the most advanced users, these contacts should only be connected to each other.

By connecting the **TRIG** outputs and inputs in various ways, a pulse distribution circuit is defined.



Multiple **TRIG** or **PASS** outputs can be connected to a single input. In this case, the appearance of a trigger pulse at any of the outputs activates the cell.



One **TRIG▶** or **PASS▶** output can be connected to several inputs, thus activating several cells at once.



LYRA▶ output can also be used as a trigger source. But unlike the **TRIG▶** output, it does not connect to the ground briefly at the moment the cell goes into an inactive state. Instead, at the moment the cell is activated it remains grounded while the cell is active (the phase switch can invert this behavior). Thus, the cell connected to it will be activated in a completely different way.



CV▶ output can also be used as a trigger pulse source. It will remain a trigger source until the output voltage goes below 2.5 volts.



PULSAR▶ output can also be used as a trigger pulse source. It generates a trigger until the voltage on **PULSAR▶** is 0 volts.

Control of delay/cell activity time:

Inputs **▶CV** and **▶X2** are used for time management.

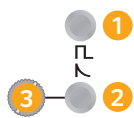
The voltage on **▶CV** determines the charge rate of the capacitor; a positive voltage on **▶X2** doubles the capacitance of the capacitor.

Consider what commutations for this control are possible:

- **CV▶** output of any cell can be connected to input **▶CV** of any cell. In this case, the delay time (capacitor charge time) in the controlled cell will decrease as the control cell moves from the beginning of its activation to its completion and the voltage at its output **▶CV** will increase.
- **PULSAR▶** output of any cell can be connected to the input **▶CV** of any cell. In this case, the delay time / activity of the controlled cell will very much depend on the activity of the control cell. When the control cell is inactive, the delay time of the controlled cell will be from 25 seconds to several minutes (depending on the position of the **TIME** knob). When the control cell is active, the controlled cell will have a delay time of 50 milliseconds to 25 seconds (depending on the position of the **TIME** knob).
- **LYRA▶** output of any cell can be connected to the input **▶CV** of any cell. In this case, activation of the control cell will cause an extension of the delay time/activity of the controlled cell to 25 seconds – 2 minutes (depending on the position of the **TIME** knob). This long “freezing” function of individual cells can be used very effectively to create complex evolving compositions.
- **PULSAR▶** or **CV▶** outputs of any cell can be connected to input **▶X2** of any cell. Activation of the control cell will double the delay time / activity of the controlled cell.
- You can combine several outputs together (**PULSAR▶**, **LYRA▶**, **CV▶**). The resulting voltage will be the arithmetic average of the voltages at the combined outputs at each point in time.
- You can connect one output to multiple inputs.

ADDITIONAL BLOCKS AND CONNECTORS

PULSE CONVERTERS



The ORNAMENT contains four identical pulse converters combined with contact-minijack adapters. Their purpose is to convert the rectangular output pulses of the ORNAMENT into short trigger pulses suitable for triggering drum modules, such as PULSAR or Eurorack.

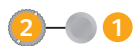
- 1 Contact input of a rectangular pulse.
- 2 Contact output of the trigger pulse for the drum module.
- 3 3.5mm minijack connected to pin 2 (adapter in Eurorack format)

In order to connect the ORNAMENT to PULSAR as a drum pattern sequencer, connect the selected outputs of the **PULSAR** cells to input pin 1 of the converters, and connect output pin 2 of the converters to the input **TRIG** of the PULSAR drum synthesis modules. Connect one of the **GND** ORNAMENT pins to the **GND** PULSAR pin.



Do not forget to always connect the ground of the ORNAMENT with the ground of the device to which it is connected.

3.5 MM MINI-JACK (EURORACK) ADAPTER SOCKETS



Designed to connect a Eurorack system to the ORNAMENT.

Pin 1 is connected to the 3.5 mm minijack 2. The ground of the minijack is connected to the ORNAMENT ground, therefore it is not necessary to connect

the Eurorack system ground to the **GND** ORNAMENT pin.

The ORNAMENT has four separate adapters along with four adapters combined with pulse converters. The adapters combined with pulse converters can also work on their own. If nothing is connected to input 1 of the pulse converter, its output 2 is in a floating state and you can use it as an adapter input to a Eurorack system, connecting any outputs and ORNAMENT inputs that you want to connect to the Eurorack system.

POWER SOCKETS



The ORNAMENT has two power sockets connected in parallel. These can power LYRA or PULSAR and one or more ORNAMENTS from a single power supply. To do this, connect the power supply to one of the ORNAMENT sockets, and connect the power socket of the next device to the second ORNAMENT socket using the supplied power cord. The ORNAMENT consumes only a small current – from 10 to 50 milliamps, depending on the operating mode, so any SOMA power supply is capable of simultaneously powering several ORNAMENTS and one other device.

To power the ORNAMENT, use the included PSU or the PSU from LYRA or PULSAR, or any stabilized +12 volt power supply, with plus in the center and an output current of at least 100 milliamps.

If several ORNAMENTS or ORNAMENT and another device are connected to a single PSU, it is no longer necessary to connect the ground of these devices via GND contacts. Ground will be connected through the power cords.

CONNECTION TO LYRA·8

The ORNAMENT interacts really well with LYRA·8, complementing its organismic synthesis with no less organizational sequences:) Actually, the ORNAMENT was originally developed as a sequencer suitable for LYRA, as using a traditional step sequencer for LYRA is unbecoming. But the ORNAMENT greatly exceeded our expectations, so we added the ability to integrate it both with PULSAR and with any Eurorack systems.

To connect the ORNAMENT to the LYRA, we developed a special adapter-pad (sold separately), which sits on top of LYRA's sensors. This allows you to connect external control circuits to them, while maintaining the ability to play using the sensors by putting your fingers to the gold-plated contact pads on the adapter. Connect pins 1–8 of the adapter to the LYRA▶ ORNAMENT outputs, and the GND pin of the adapter to the GND pin of the ORNAMENT.



You can do it without the adapter if you use suitable clips that can be attached to LYRA's sensors. In this case, the GND ORNAMENT pin must be connected to any of the lower LYRA sensors (bottom row).

You can also connect the outputs of the **PULSAR▶** and **CV▶** of ORNAMENT to the CV inputs of the LYRA located on the rear panel. To do this, use the 3.5 mm contact-minijack adapters on ORNAMENT and 3.5 mm jack – 6.3 mm jack cords, or simply connect a crocodile clip to the pin on the end of the 6.3 mm jack connected to the LYRA.

CONNECTION TO PULSAR·23

The ORNAMENT offers perfect control of the PULSAR, making its rhythmic patterns much more diverse and allowing you to create elegant generative compositions using only these two devices.

To trigger drum synthesis modules, use ORNAMENT pulse converters (see the "Pulse Converter" section) connected to the **PULSAR▶** outputs.

You can control various parameters of PULSAR synthesis by connecting the corresponding PULSAR CV inputs to the **CV▶** or **PULSAR▶** outputs of ORNAMENT. The **LYRA▶** output can also be used for some inputs, but do not forget that in the active state it is simply connecting to the ground. Therefore, it will not have any effect until there is some voltage at the input contact. In the PULSAR, such contacts can be TRIG, inputs of MOD filters, EXT inputs of synthesis modules, and inputs for controlling the parameters of the FX processor. Do not forget to always connect the **GND** of the ORNAMENT with the **GND** of the PULSAR and any other device to which it is connected!

You can also control the ORNAMENT by using the various outputs of the PULSAR.

We recommend trying out the outputs of the clock divider, the outputs of the LFO and the outputs ENV of the envelope generators. The intertwined PULSAR and ORNAMENT are capable of generating compositions that go beyond understanding.

Vlad Kreimer

MASTERING THE INSTRUMENT

Since ORNAMENT was originally developed for LYRA•8, we will try to show the practical techniques of patching and playing with the example of ORNAMENT driving LYRA.

Connect each **LYRA▶** output to the corresponding metal contact of the LYRA•8 using the adapter pad (sold separately). Connect the **GND** ORNAMENT pin to the **GND** pin of the adapter so that both devices have a common ground and are ready to communicate. We also recommend bringing LYRA and ORNAMENT to the configuration shown in the picture (everything is turned off except for voices that are in organ mode). **Pic. 1**

Now press any **SET** button. The corresponding voice of LYRA will begin to sound. This happens because the voltage created at the output of **LYRA▶** leads to the triggering of the corresponding LYRA sensor. The same thing happens when you touch these sensors with your fingers (or other conductive objects).

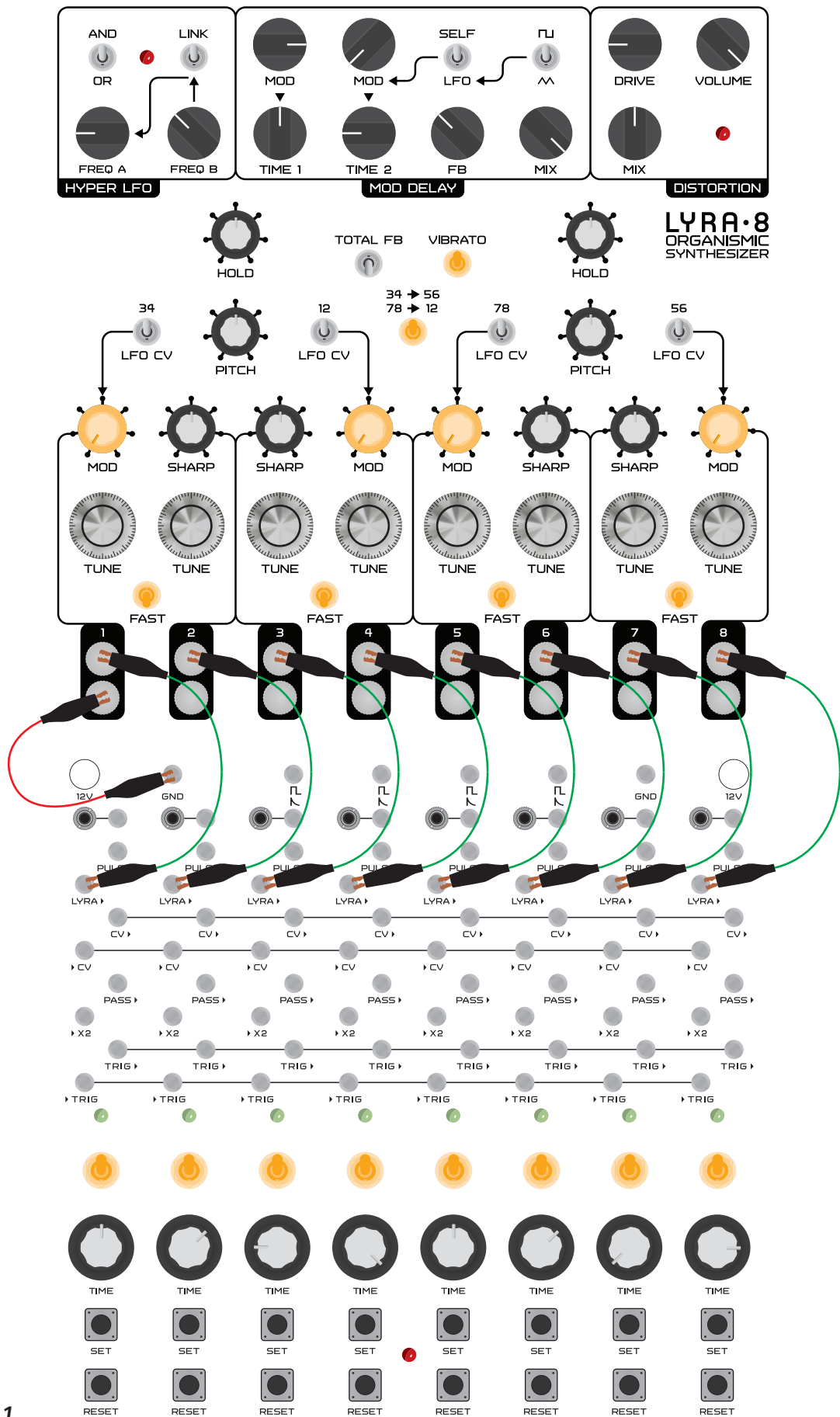
The ORNAMENT cell makes LYRA's voice sound for a certain amount of time, which is determined by the position of the **TIME** knob. We will say that during this time period this cell is active, and this period itself will also be called the duration of the cell activity. The ORNAMENT is able to "hold" LYRA's voices in a wide range of times — from fractions of a second to several tens of seconds and even minutes (under certain conditions).

The cell is active while the **SET** button is pressed, if the duration of the press exceeds the value set with the **TIME** knob.

To turn off the active cell before the value set with the **TIME** knob has elapsed, press the corresponding **RESET** button.

A cell can operate in three modes: positive, negative and pause mode. If you flip the phase toggle switch from a positive (up) to a negative position (down), the ORNAMENT will begin to "hold" LYRA's voice indefinitely. Pressing **SET** will cause the ORNAMENT to stop "holding" LYRA for a while. **RESET** aborts this action. In negative mode, the cell outputs are inverted. While the ORNAMENT is "holding" LYRA's voice, the indicator lights up.

If you put the toggle switch of the cell in the middle position, then the ORNAMENT will no longer be able to "hold" LYRA under any circumstances. The output state **LYRA▶** no longer changes. However, this does not mean that nothing happens on the other outputs of this cell or generator.



Pic. 1

PATCHING AND ALLIGATOR CLIPS

Initially, I planned to create a sequencer for LYRA with a small set of predefined patches (cell connections), which "would be enough" for comfortable playing. Eight in a row, two pairs of four, and so on. But the very first prototype showed that this approach is not suitable. LYRA is a polyphonic FM synthesizer, and classical sequencers with a linear loop structure will not take full advantage of its synthesis capabilities. A sequencer with a non-linear structure and very dynamic behavior was needed. As a result, ORNAMENT is a sequencer that always needs to be patched.

As in PULSAR, ORNAMENT patches are created using special contacts and alligator clips, which are a great solution and have an excellent price/quality ratio compared to 3.5mm minijack connectors.

Moreover, the ORNAMENT also has eight 3.5mm minijack adapters for connecting with Eurorack.

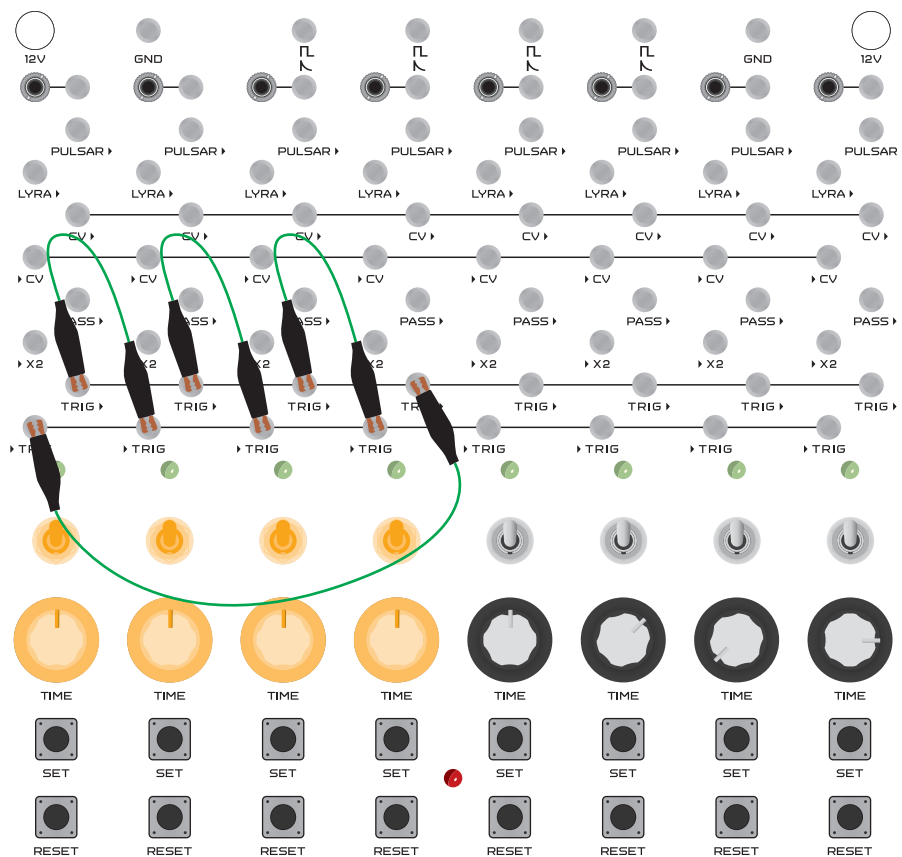
All inputs of ORNAMENT cells or state generators are marked ▶ at the beginning, and outputs are marked ▶ at the end. I will use the cell number in parentheses to indicate which cell the contact belongs to. For example, ▶TRIG 1 is a trigger input of the first cell, and TRIG▶ 6 is a trigger output of the sixth cell.

Let's start creating your first patch. This patch is intended to demonstrate the ability of the ORNAMENT to create complex, lively, unexpected and unpredictable patterns that will allow LYRA and PULSAR to sound like they've never sounded before.

Connect the TRIG▶ 1 to the ▶TRIG 2. Put all cells in positive mode by flipping the switches to the up position. Press and release the SET button on the first cell to activate it. The ORNAMENT will "hold" the first voice during TIME 1. As soon as the first voice ceases to sound, the second voice will begin to sound. When the second voice is done, the sound will stop. This is the simplest cell connection. At that moment, when the first cell ceases to be active, the ORNAMENT ceases to "hold" LYRA's voice, and its output TRIG▶ 1 generates a short trigger pulse. The input of the second cell ▶TRIG 2 receives this signal through the connection that we made, and instantly activates the second cell, and the output LYRA▶ 2 of this cell goes into the "hold" state. At the moment when ORNAMENT "releases" the second voice, its output TRIG▶ 2 also generates a short trigger. But this trigger has no destination.

The ORNAMENT allows you to transfer a trigger from the TRIG▶ output to any cell, with the exception of the one that generated it. You can pass a trigger with TRIG▶ 2, for example, to ▶TRIG 1. Then we get a loop of two voices sounding in turn. But for further demonstration, you need to create a loop of 4 cells. To do this, also connect TRIG▶ 2 to ▶TRIG 3, TRIG▶ 3 to ▶TRIG 4, and TRIG▶ 4 to ▶TRIG 1. Cell activation signals will not be lost, because each is directed to the corresponding input. I will designate this loop LOOP 1234 — the numbers in rectangles give information about the direction in which the signals go along this loop. In this case, the direction is 1→2→3→4→1→... In other words, the order of the numbers inside the rectangles is important.

Press SET on any of the cells from LOOP 1234 to start the ORNAMENT. Now it is moving through LYRA's voices one by one. Tune them with the TUNE knobs on the LYRA, and use the TIME knobs to make the duration of the sound of the ORNAMENT cells about equal to each other. *Pic. 2*



Pic. 2

The ORNAMENT allows you to create loops of any length, with a minimum of 2 steps or cells. If you need a loop length of, for example, 64 steps, you need to take eight ORNAMENTs and merge their cells into one chain.

Music is impossible without pauses or rests. Switch any cell from positive mode to pause mode (middle position of the toggle switch). Now the corresponding LYRA voice will no longer sound. However, the cell is still involved in the creation of the rhythm, because the trigger pulses at its inputs and outputs continue to be transmitted. This mode of operation is useful when you need to turn off some of LYRA's voices, or in order to use cells for other purposes. Please note that when this cell is switched to negative mode, the rhythm also does not change – only the mode of operation of the cell outputs is inverted. Let's return this cell to positive mode by flipping the switch up again.

▶TRIG inputs are capable of receiving a signal from any number of ▶TRIG outputs. ▶TRIG outputs are able to transmit a signal to any number of ▶TRIG inputs.

Using this property, we will complicate **LOOP [1234]** a little, but at the same time we will immediately go beyond the territory of ordinary linear sequencers. Send a trigger with **▶TRIG▶[3]** not only to ▶TRIG[4], but also to ▶TRIG[5]. Press **SET** of any of the **LOOP** cells **[1234]** to start the ORNAMENT. Set the **TIME[5]** value of the fifth cell so that it lasts longer than the fourth cell. Switch LYRA to the mode so that voices 3 and 4 modulate voices 5 and 6. We will increase the modulation level with the **MOD** knob **[5, 6]**. Now the result of the FM synthesis between 4 and 5 voices of LYRA is clearly audible, when both of these voices sound simultaneously.

Experiment with the duration of the fifth cell. If the duration of its sound is about equal to the sum of the durations of the sound of the first four cells that formed a loop, this cell will sound almost constantly. However, if you put cell 5 in a negative mode of operation, then

on the contrary it will almost always be silent. Experiment with the duration of the cells, as well as the mode of their operation, to find interesting tones at the moments when two or more LYRA voices sound connected in the FM synthesis mode. **Pic. 3**

This principle of creating durations is more like how we create music when we simply play a musical instrument. We think in lengths of sounds and pauses between them. Later, in order to effectively interact with other musicians, we are forced to put music on a grid, relative to which everyone else will be guided.

Pass the trigger by connecting **TRIG▶5** (put this cell in positive mode) to **▶TRIG1** to complicate the patch a bit more (connection **TRIG▶4**—**▶TRIG1** remains). Now the first cell is activated not only when the fourth cell "releases" LYRA, but also when the fifth cell also "releases" LYRA. You can set the length of the fifth cell so that all the cells will almost constantly "hold" LYRA. To avoid this, you can put them all in negative mode. The pattern in the end turned out to be very complicated, but if you change the duration of the first and fifth cells, the behavior will instantly change. Therefore, ORNAMENT-8 is a synthesizer of behavior, which only in some special cases can be called a sequencer in the usual sense. Connecting each of the remaining inputs and outputs increases the functionality and complexity of the behavior of the ORNAMENT many times, if not exponentially.

Put all used cells in positive mode. Remove the connections **TRIG▶5**—**▶TRIG1**, **TRIG▶3**—**▶TRIG5** so that only **LOOP1234** remains. Set the **TIME** durations of all cells so that they are about the same. Start **LOOP1234** with one of the **SET** buttons. Then activate another cell from **LOOP1234** so that two cells are active in the loop at each moment. If the **TIME** parameters are equal for all four cells, then three cells, or even all four, can be active in the loop. But such states will not be stable and soon enough the number of active cells in this loop will decrease to two.

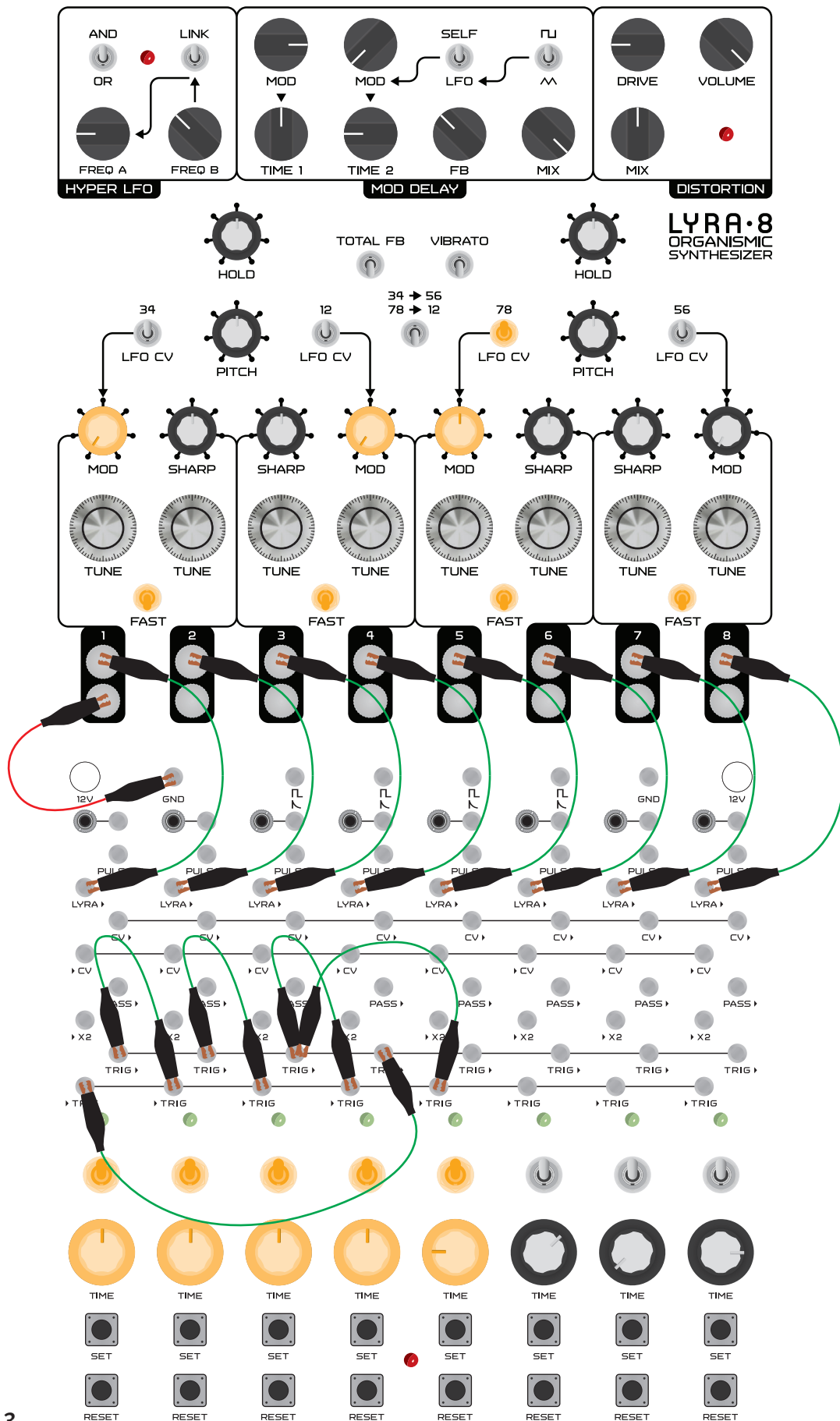
In a sense, this is the natural mechanism of the ORNAMENT, which does not allow too many cells in the loop (and therefore too many LYRA voices) to be active at the same time. As long as the cell is active (and "holds" LYRA), its input **▶TRIG** is not susceptible to new trigger pulses. And if almost all cells are active in the loop, the "eating" or absorption of new incoming pulses by already active cells is inevitable. The reasons for this lie in the unequal time of the activity of the cells.

Since the ORNAMENT has a completely analog circuit, the cell durations can be approximately equal, but they will never be exactly equal. One of the cells will inevitably work longer than the others by a small margin, and sooner or later it is bound to "eat" an additional pulse circulating in the system, thereby removing it.

Let's call such moments "collisions", when our system, as a result of extraordinary events, by itself radically changes its state.

Linear sequencers avoid collisions, they are simply not possible. There is a main Master Clock that dictates to everyone when to "go," and when to "stand." In the ORNAMENT, each part is equal. All involved cells participate in the formation of all states at all inputs and outputs, while living their individual lives, so to speak, in their own independent rhythm. If you remove or rebuild one of the links, the result will immediately change. Collisions are the essence of ORNAMENT, which makes it the first sequencer of its kind.

Hold **RESET** on any of the **LOOP1234** cells to clear the loop by causing all pulses to be "eaten". At the moment the **RESET** button is pressed, the active cell instantly turns off (stops "holding" LYRA), and a trigger is generated at the **TRIG▶** output. If after pressing it, you continue to hold **RESET**, then the input **▶TRIG** of this cell will be blocked and will not



Pic. 3

be able to receive trigger pulses. The cell will "eat" the trigger pulses until there are none left, thus clearing the loop after one cycle.

Explore the nature of collisions. Set the durations of the **LOOP 1234** cells to be approximately equal to each other. Using the **SET** buttons, simultaneously (as much as possible) activate the first and third cells. An active pair of cells starts to "move" in the loop: 1 and 3, 2 and 4. Note that from the point of view of ORNAMENT (more precisely, from the point of view of trigger pulses on **TRIG** and **TRIG**), two parallel state transfer processes occur: $1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 1 \rightarrow \dots$ and $3 \rightarrow 4 \rightarrow 1 \rightarrow 2 \rightarrow 3 \rightarrow \dots$. And from the point of view of LYRA's voices, it might seem that the transfer processes are different: $1 \rightarrow 2 \rightarrow 1 \rightarrow \dots$ and $3 \rightarrow 4 \rightarrow 3 \rightarrow \dots$. Which is equivalent to two independent loops of ORNAMENT.

Increase the duration of one cell from **LOOP 1234**. In a few loop cycles, the pair will cease to exist. The "fast" cell at the moment of switching off will try to transfer the trigger to the blocked input of the "slow" cell at the moment when it is active. As a result, only one active cell will remain in the loop. There is no way to avoid this process. Each time after the **SET** button is pressed, the "slow" cell will very quickly absorb the "fast" cells.

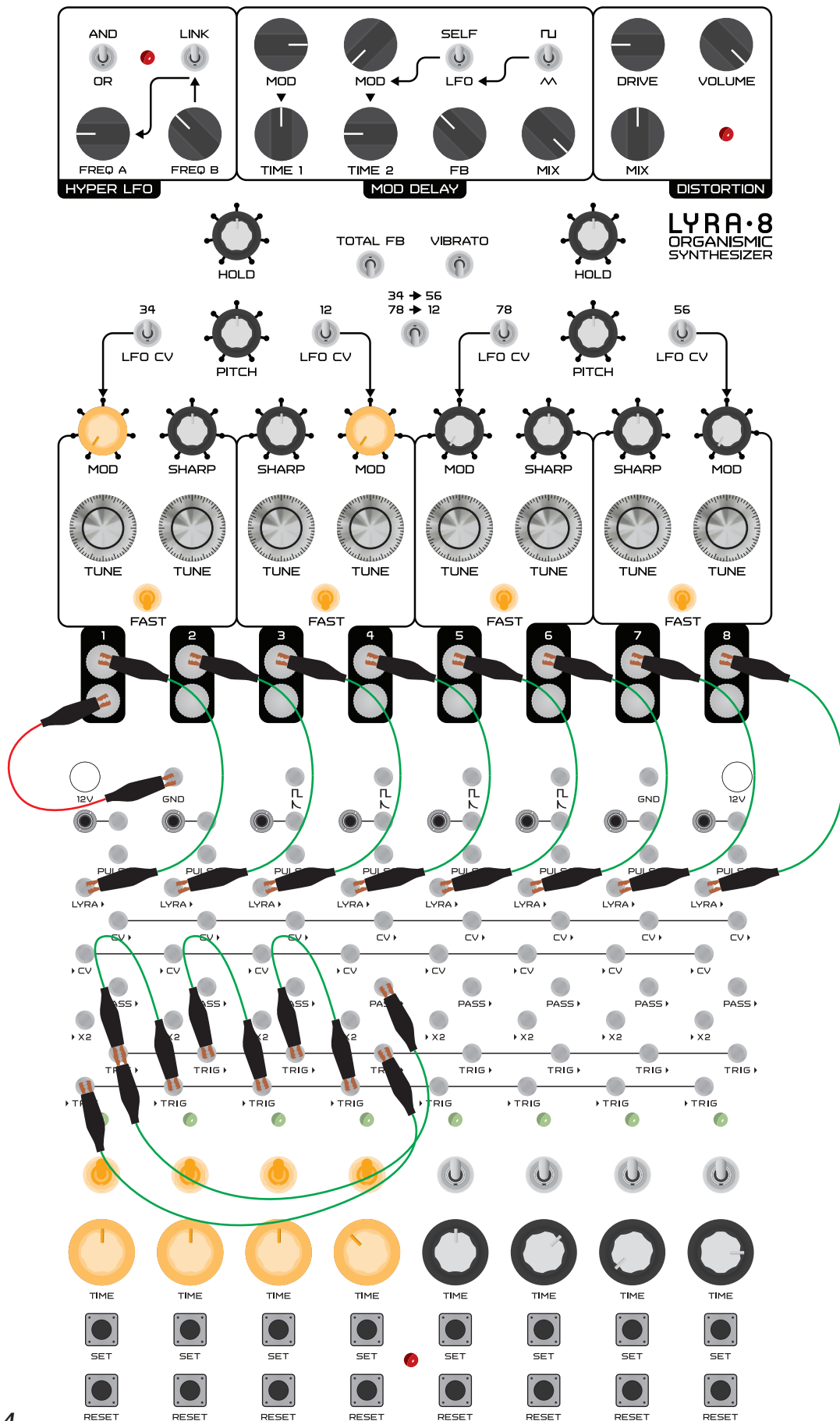
It's possible to calculate approximately the number of cycles for which a collision occurs in a given loop. Let's say that cells 1 and 3 are started simultaneously in **LOOP 1234**. We also assume that the durations of the first three are the same and equal to **TIME 1**, and the duration of the fourth exceeds the duration of the others by dT (difference in time), which is slightly less than **TIME 1** (a slight difference). In this case, on each cycle, the fourth cell will be late with dT turned off for this time. And the second active cell in this loop will "catch up" with it a little. In order to completely "catch up" with it and try to pass the trigger, it needs to overcome the time **TIME 1**. For each cycle, it overcomes dT . So the collision will happen through $\text{TIME 1} / dT$ cycles. You can understand this in practice simply by observing the ORNAMENT.

This situation will be repeated always when the cell durations are at least slightly different. As a result, there will be only one active cell in the loop. But cell durations create the rhythm of our pattern – therefore, we should be able to make them different without losing polyphony. Intuition provided me with a solution to this problem – a trigger that hits a blocked input should not be wasted. The user-specified polyphony must be retained. This is how the **PASS** output came to be.

Set the durations of the **LOOP 1234** cells equal to each other. Double the length of the fourth cell compared to the rest. Use the **SET** buttons to start two cells simultaneously. Make sure that very soon only one cell remains active. Connect the output **PASS 4** to the input **TRIG 1**. Run a pair of cells in **LOOP 1234**. Now, every time the third cell sends a trigger pulse to **TRIG 4** while it is active, the signal skips through **PASS 4** and activates the first cell. As a result, polyphony of 2 voices is preserved in the loop. *Pic. 4*

However, when the fourth cell tries to transfer the trigger to the first while it is active, we again lose the second "voice" of the polyphony, because the output **PASS 1** is not connected to anything. And such a collision will surely happen sooner or later. You can connect **PASS 1** to **TRIG 2** to continue to struggle with asynchrony in this loop. But then you have to connect **PASS 2**, and so on...

There is a much better solution. Connect **PASS 1** to **TRIG 5**. Switch the fifth cell into the positive mode of operation and make its duration noticeably shorter than the duration of cells 1,2,3. Use the **SET** buttons to start two cells in **LOOP 1234**. Now you need to wait until the trigger from the output **PASS 1** jumps to the input of the fifth cell, which will begin



Pic. 4

to "hold" LYRA's fifth voice. How often this trigger will skip depends on the **TIME** value of the fourth cell. Moreover, this connection is nonlinear. Note that when a trigger arrives at the input of the fifth cell, only one cell is active in loop 1-4. Let's return polyphony to this loop, but with a delay.

Connect **TRIG▶5** to **▶TRIG 3**. Make the fifth cell duration very long compared to the **LOOP 1234** cycle. Thus, polyphony will return to the loop, but after a certain time, which is determined by the duration of the fifth cell. If you put the fifth cell in pause mode, then we will not hear LYRA's voice. But at the same time, the fifth cell will act as a temporary storage of the trigger pulse of the second active **LOOP 1234** cell. *Pic. 5*

Behind all these collisions and "running around" cells, one should not forget that ORNAMENT is a tool that provides additional opportunities for playing LYRA•8. Now you can create some kind of behavior on the ORNAMENT that triggers the LYRA•8 and focus all your attention on changing the sound of LYRA. While the ORNAMENT is playing the LYRA, you can smoothly change the pitch of its voices, vary the modulation value, and change the FM synthesis algorithm.

The ORNAMENT also provides additional opportunities for controlling the presence of each voice in the final sound. If a voice is too annoying or is currently out of tune, you can simply switch the ORNAMENT cell corresponding to that voice to pause mode. The rhythmic pattern will not change, but this voice will cease to be audible. There are situations when LYRA's voice takes up more space than you would like, but you don't want to turn it off completely — you just want to reduce its presence. Simply switch the cell corresponding to this voice to the negative mode. Now all periods of sound will turn into pauses, and pauses will sound instead. The rhythmic pattern will not change in terms of the ORNAMENT cells and the interaction of its trigger outputs and inputs. But the resulting sound of LYRA will change significantly. For additional changes, you can switch several cells at once to negative mode.

The patch that we created is the most basic and simply demonstrates the operation of some inputs and outputs. Your task now is to learn how to create your own patches. Make the cells begin to communicate with each other. For example, make it so that two loops, not connected to each other, exchange rare events and create new soundscapes.

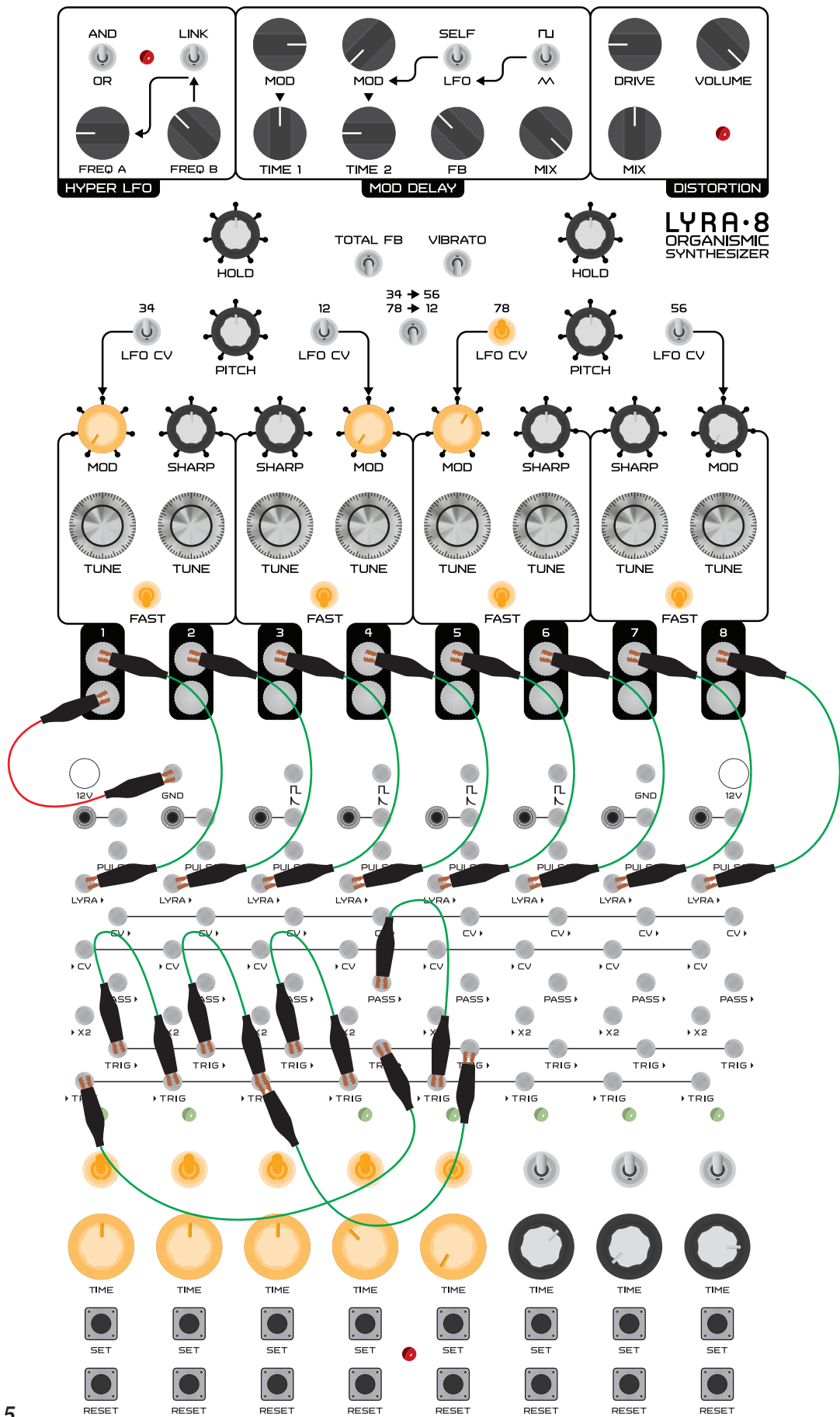
Once I created a patch in which there was one loop of four cells. With the help of additional cells that were in pause mode, I made the polyphony in this loop smoothly change. First, one voice, then there were two, then three, then again two, then one. The cycle was repeated in 1 minute.

I am sure that we are just beginning to study the unique capabilities of systems such as ORNAMENT. This is a one of a kind musical instrument. And you also need to learn to play it. But in this case, the playing means creation and modification of patches that generate the composition in a very unusual way for the human mind.

The remaining inputs and outputs of the ORNAMENT can create and receive control signals. These signals can, for example, change cell durations directly during operation. This is an example of the "butterfly effect" within the ORNAMENT — nothing will go unnoticed.

Input **▶X2**. If a positive voltage is applied to this cell input (more than 1 volt), then the time corresponding to the **TIME** parameter of this cell will double.

Positive voltage in the ORNAMENT can be obtained in two ways: **CV▶** and **PULSAR▶**. When the cell is active, "holds" LYRA and its indicator is lit, then **PULSAR▶** has a high voltage level of +10 volts. The voltage at the **CV▶** output at this moment rises from 0 volts to 10. When the cell is not active, **CV▶** and **PULSAR▶** are low.



Pic. 5

Let's go back to **LOOP [1234]** and the fifth cell, which temporarily stores the trigger pulse that comes to it from **PASS▶[1]**. So far, this trigger is the most interesting thing that happens in this patch. The longer **TIME[1]**, the more often this trigger passes to the fifth cell. To diversify the patch and, at the same time, to more or less maintain its behavior, can be done as follows. Create a condition:

1. While the fifth cell is not active, the first cell should be long.
2. When the fifth cell is active, the first cell should become 2 times faster.

The whole process of patching the ORNAMENT consists of creating such conditions. In your mind, these conditions are best formulated as hypotheses. "Will there be any interesting behavior if you slow down and accelerate the cell which generates the rare trigger pulse?" From successful hypotheses, patches are born that give an extremely interesting sound. The more you interact with the ORNAMENT, the more courageous your hypotheses will be.

Back to the condition. You can implement it using the input **▶X2[1]**. It is enough to apply a high voltage to it when the fifth cell is not active. To do this, connect **PULSAR▶[5]** with **▶X2[1]** and turn on the negative (inverted) mode of operation in the fifth cell.

But now LYRA's fifth voice began to sound. Suppose it is important to keep it silent. It is enough to disable the clip, which connects LYRA's voice with the ORNAMENT. This is another way to put a cell in pause mode. **Pic. 6**

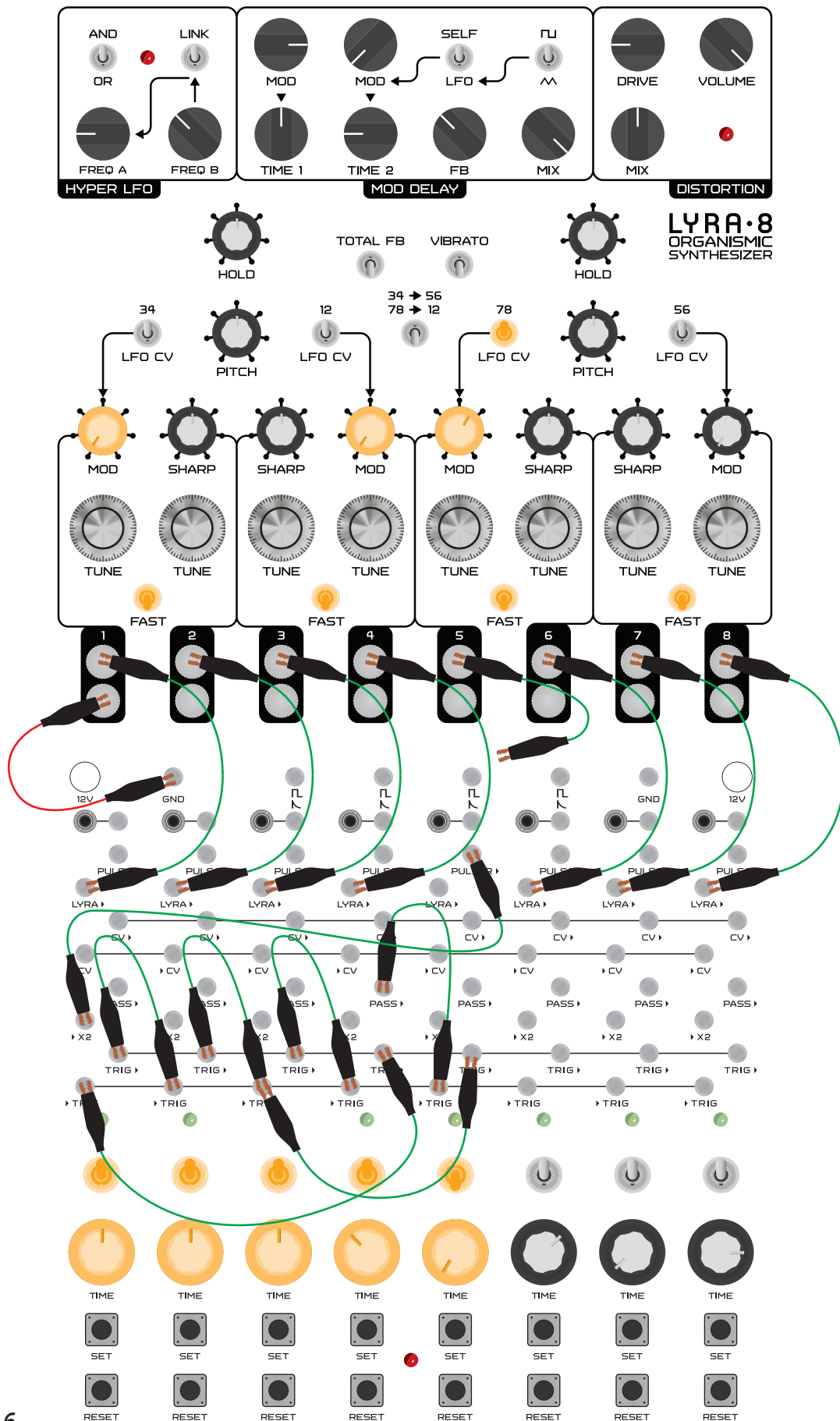
Now you need to choose values of **TIME[1]** and **TIME[5]** that will create interesting behavior, and thereby an interesting musical sequence.

By the way, **▶X2** is not as simple as it seems. If a high level voltage is applied to this input during the entire period of activity of a cell, then the duration of this cell doubles. If you keep a high level at this input only part of the activity period, then the behavior of the cell becomes more complicated.

Imagine a water tank. As soon as the cell is activated, it begins to fill with water. Water fills it during **TIME**, after which the cell turns off, and the tank instantly empties and waits for the next activation. A high voltage on **▶X2** opens a valve connecting this tank to an identical second tank. Therefore, with the valve constantly open, the first tank is filled twice as long. If the valve is closed during filling, the first tank will fill the remainder at the original speed. But some water level in the second tank will remain. And during the next valve opening, this water will merge with water in the first tank (communicating vessels), which will speed up the process. Consequently, the filling time will not be **TIMEx2**, but less. Such a system "remembers" what happened to it before, therefore we can also call this function "MEMORY".

However, this behavior does not lead the system into chaos. It adds a very pleasant organic swing to the behavior of the ORNAMENT. Create two loops **LOOP [1324]** and **LOOP [576]**, where all the cells are in positive mode (**LYRA▶[5]** connects back to LYRA's fifth voice). These loops will constantly activate voices from different LYRA groups, which will create many interesting intersections of voices that play simultaneously. These voices in FM synthesis mode significantly expand the sound palette. Let the first loop of **LOOP [1324]** be fast enough, as far as the LYRA envelope allows. The second loop **LOOP [576]** should be slower. Now connect the outputs of the **PULSAR▶ LOOP [576]** cells to the inputs **▶X2** of the **LOOP [1324]** cells. Listen to how the durations started to wander a bit. The amount of their wandering is directly related to the duration of the control cells. **Pic. 7**

Nothing prevents creating feedback when the outputs of **PULSAR▶** cells from **LOOP [1324]** also control the durations of cells from **LOOP [576]**. It is not known in advance what the



Pic. 6

result will be. Always remember to experiment and create hypotheses that could potentially lead to interesting behavior.

Additionally, you can diversify this patch using the **PASS** output. Create a situation where the trigger will "fly out" of the loop through this output to another loop. And after some time it will also "fly back in". This way you can create a "wandering" voice of polyphony, which will be either in one loop or in another.

You can control cell activity using the **SET** and **RESET** buttons. Premature termination of activity of one of the important nodal cells with the **RESET** button can very radically rebuild the behavior of the patch. The simplest illustration of this is **LOOP** [1324]. In a regular loop of four cells with equal **TIME** lengths, there are two stable configurations. In complex patches, there may be even more such configurations.

The **CV** output can generate a continuous voltage gradient, unlike the discrete outputs **LYRA** and **PULSAR**, which can only be in high or low states. As soon as the cell is activated, the voltage at this output begins to grow linearly. The reset moment (after **TIME** time has elapsed) occurs when the voltage on it reaches +10 volts. At this point, the voltage at the **CV** output instantly drops to zero. If the cell operates in the inverted mode, then the voltage on the contrary drops from +10 volts to the ground voltage, and then instantly rises to +10 volts.

This output can be used as a source of control voltage. Summing it with other outputs, you can create signals of a complex shape.

Input **CV** allows you to control the duration of the **TIME** generator. Unlike **X2**, this input allows you to change the duration in the full range of the **TIME** control and even beyond.

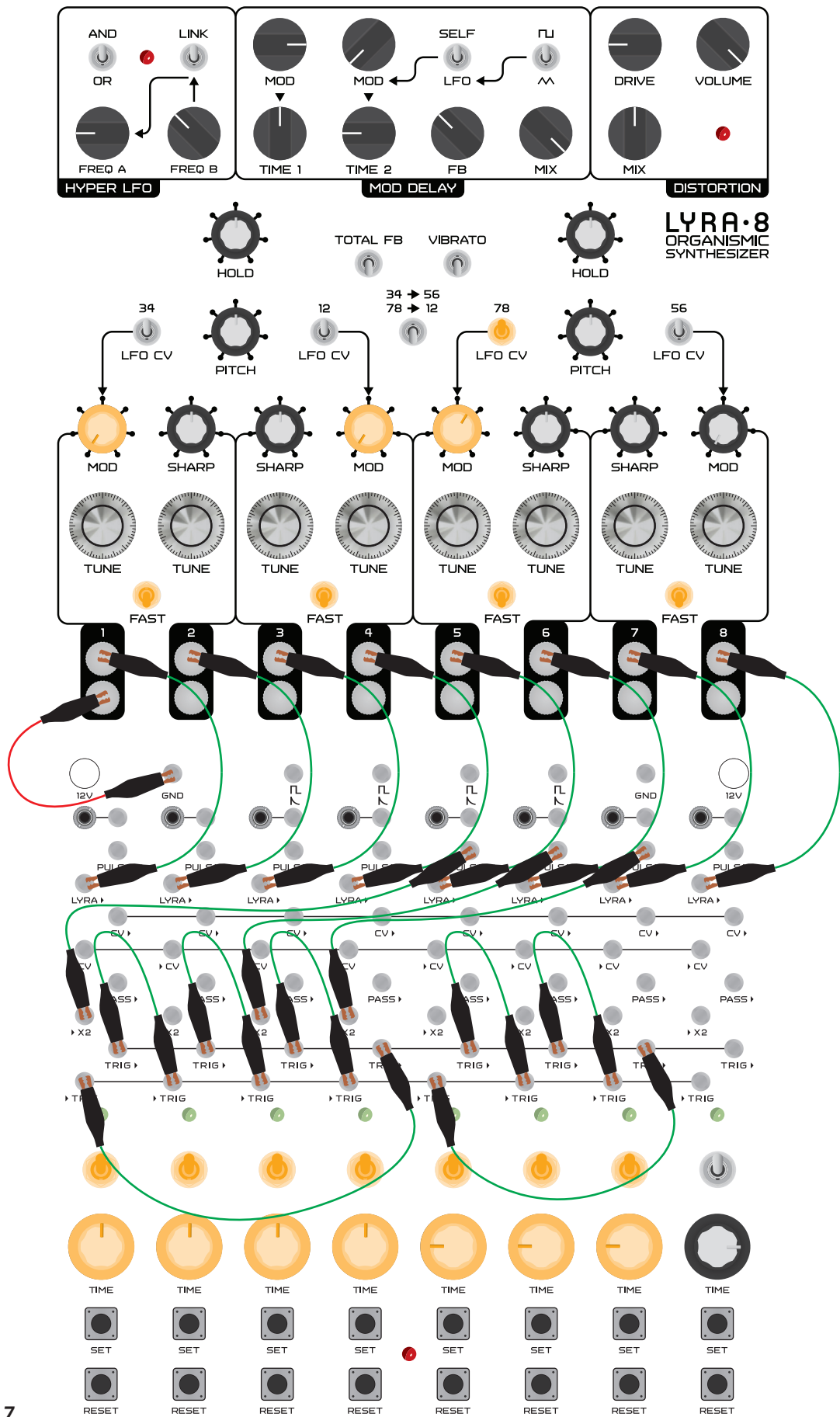
Create **LOOP** [34] and **LOOP** [56] with all cells in positive mode. Make the length of the first loop cells very short. The duration of the fifth cell is 10 seconds, and the sixth is very short. You can disconnect generators 5 and 6 from **LYRA** so that its voices remain silent. As a result, the output of **CV** [5] will result in an increasing saw. Create a connection **CV** [5] — **CV** [3] and **CV** [5] — **CV** [4]. As a result, it turns out that the rate of **LOOP** [34] is gradually increasing. *Pic. 8*

By creating feedback by connecting **CV** and **CV**, you can achieve extremely unpredictable pattern dynamics including short stops, after which the movement starts again.

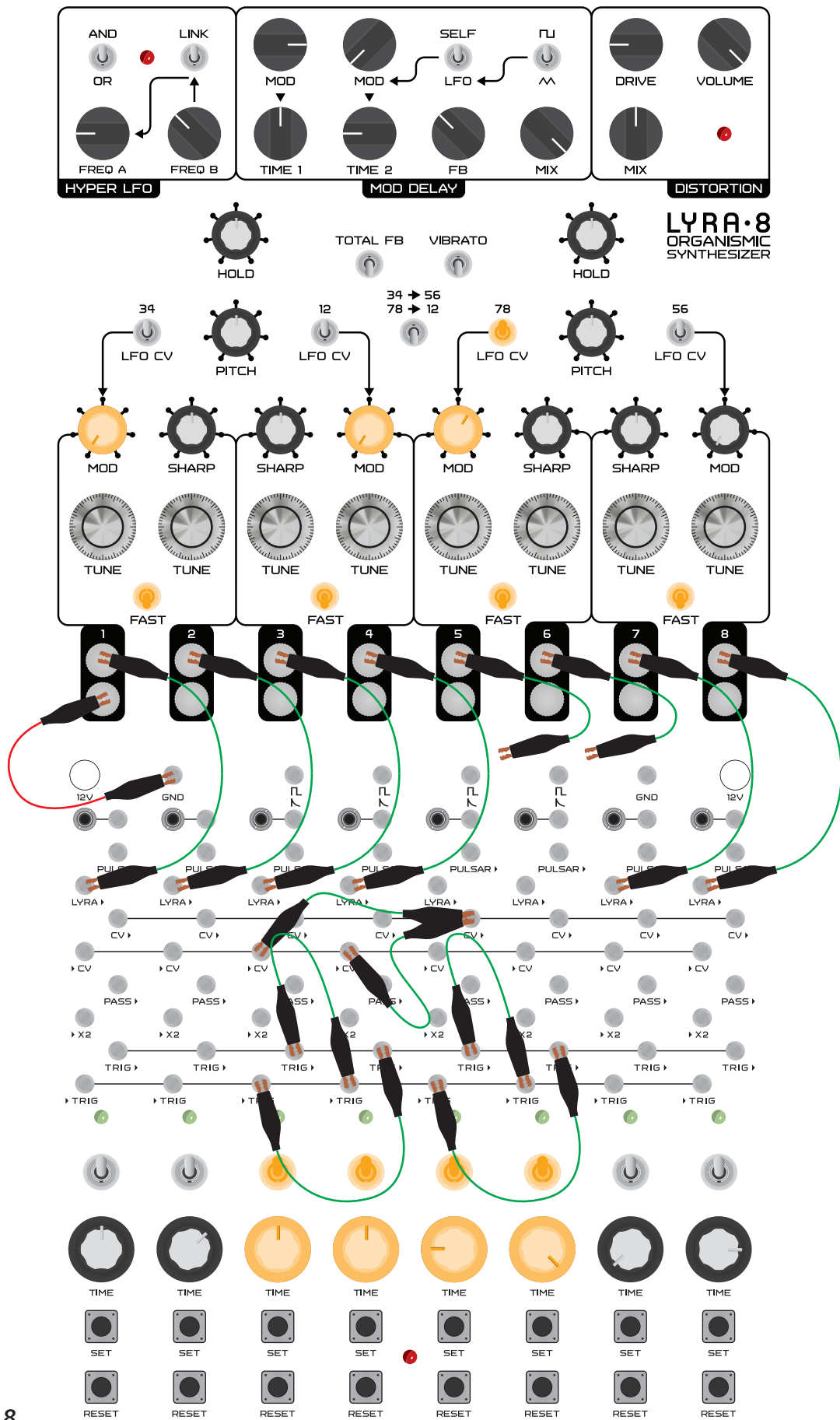
ORNAMENT stops may also be longer. During these stops, the cells retain their state. Sooner or later one of the cells will change its state and generate a trigger that will bring the whole system out of the stop.

The ORNAMENT stops completely if all the cells at a certain moment become inactive. Such situations occur in highly confused chaotic patches. Algorithms and conditions for bifurcation of behavior in such patches are very complex. The probability of multiple collisions increases sharply, and at some point they can lead to a complete shutdown of all cells. After that, only the User can return the ORNAMENT to life by pressing a **SET** button:)

Try to consider the patches of the ORNAMENT as evolving systems, and study the laws that govern their development, as they are very similar to the laws that govern our lives.



Pic. 7



Pic. 8

SPECIFICATIONS

Number of cells	8
Number of pulse converters	4
Number of 3.5 mm mini-jack Eurorack adapters	8
Number of contacts (inputs and outputs)	78
Input and output voltage range	0-10 volts *
Minimum cell delay time	50 ms *
Maximum cell delay time	50 seconds *
Maximum cell delay time at > CV = 0 volts	5 minutes *
Supply voltage	12 volt center-plus
Current Consumption	10-50 ma *
Dimensions	266x255x54 mm
Weight	1.4 kg

**As with any analog device, there may be a small variance in actual values.*

Included:

ORNAMENT•8 – 1 pc.

Power supply 12v 1a – 1 pc.

Male-male power cord – 1 pc.

65 cm cable with alligator clips – 12 pcs.

30 cm cable with alligator clips – 14 pcs.

Additionally, you can purchase:

Sensor overlay for LYRA•8 sensors

Optional cable set with alligator clips

THE PROJECT INVOLVED

Vadim Minkin – idea, philosophy, circuitry, design, texts, video.

Valery Zaveriaev – design and layout of the manual.

Victor Grigoriev – assistance in the design development, mechanical assembly.

Vitaly Zhidikov – sales, management, commercial department.

Vlad Kreimer – circuitry, design, texts, video.

Vyacheslav Grigoriev – construction and technology, production management.

Grigory Ryazanov – development of the serial version of the device.

Dmitry Zakharov – QC, adjustment.

Evgeny Aleinik – legal support for the project.

Maxim Bogdanov – PR, sales and communications.

Maxim Manakov – QC, adjustment, technical support.

Maxim Tulpakov -web development and administration

Nastya Azartsova – rendering panel and web design.

Thomas Lundberg – proofreader, editor.

Arseniy Vasilenko – web administration.

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