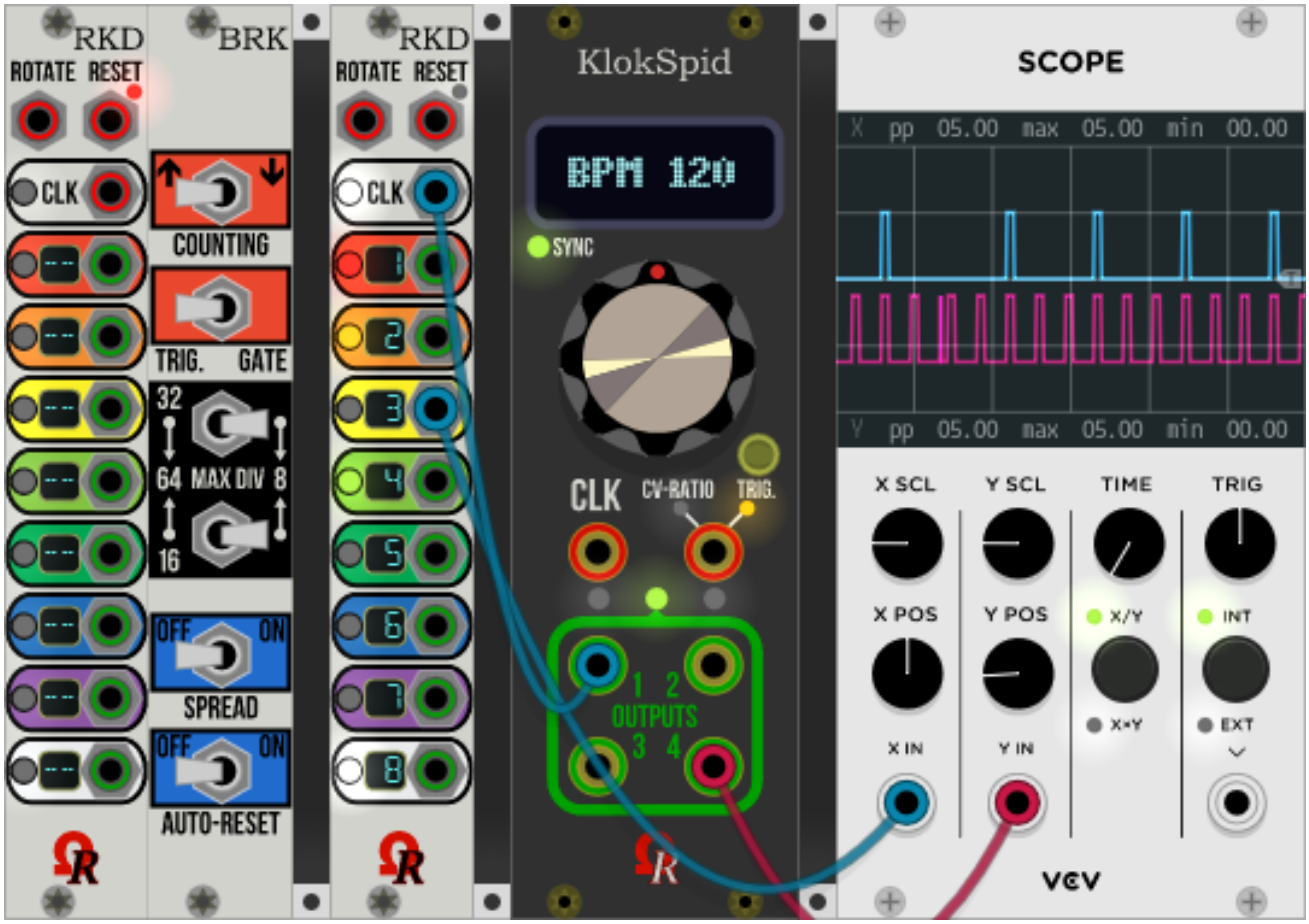
RKD / RKD with "Break" Modules for VCV Rack



User's Manual

INTRODUCTION

RKD (stands for **Rotate Klok Divider**) are basically two clock-divider modules, both having 8 output jacks (each have its divided clock ratio, all are always different at a given time), dividers are based on built-in tables (manufacturer, plus 4 "extra" tables, described later).

One of amazing feature supported (by both RKD modules) is **table rotations**.
Table rotations are controlled by external voltage (CV), applied on ROTATE input jack.
It will be explained later in this manual.

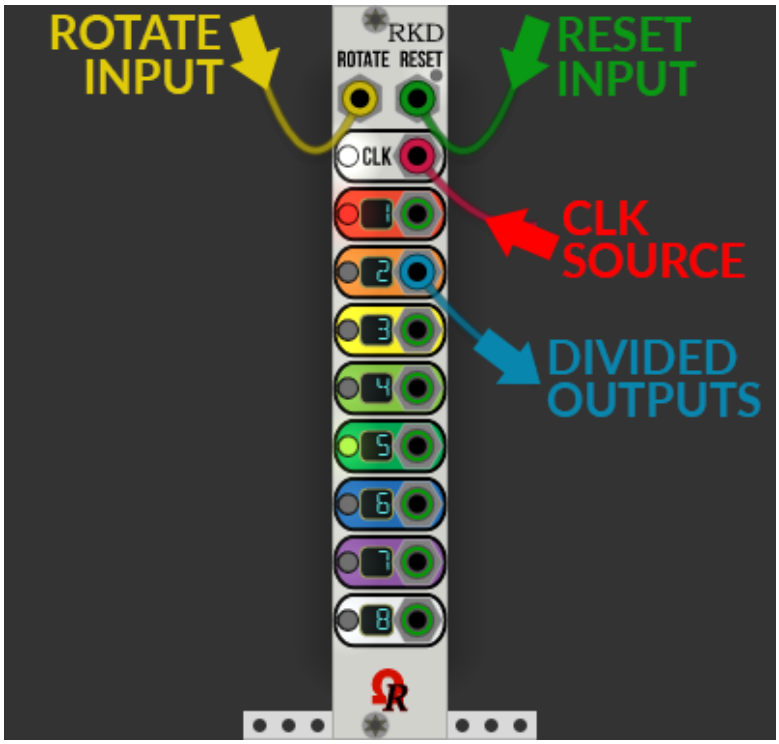
RKD is a 4 HP module (1 in./20.32mm width), it will enter easily in any rack, but its major disadvantage is the way to configure it (custom setting), done by six "jumpers" (kind of small electrical shunts) located on module's PCB (printed circuit board).

His "big Brother", **RKD with "Break",** is a widebody module, allowing a more comfortable access to module's setting, without need to access to jumpers, by offering six equivalent switches mounted on a companion panel alongside a standard RKD. This extra panel is named **BRK** ("Break") panel (or module). Unfortunately, the other side of the coin is a more larger module (8 HP, 2 in., 40.64mm width), so it requires twice space in your rack!

Both RKD (alone) and RKD with "Break" modules offer exactly the same features, this manual covers both.

MODULE LAYOUT (RKD)

RKD signal workflow is mainly from top to bottom. Both modules have three input jacks, located near top: ROTATE, RESET, then CLK. Any input have a red ring into jack. All other eight jacks (numbered "1+R", "2+R", "3+R"... to "8+R") are outputs (green rings into jacks).



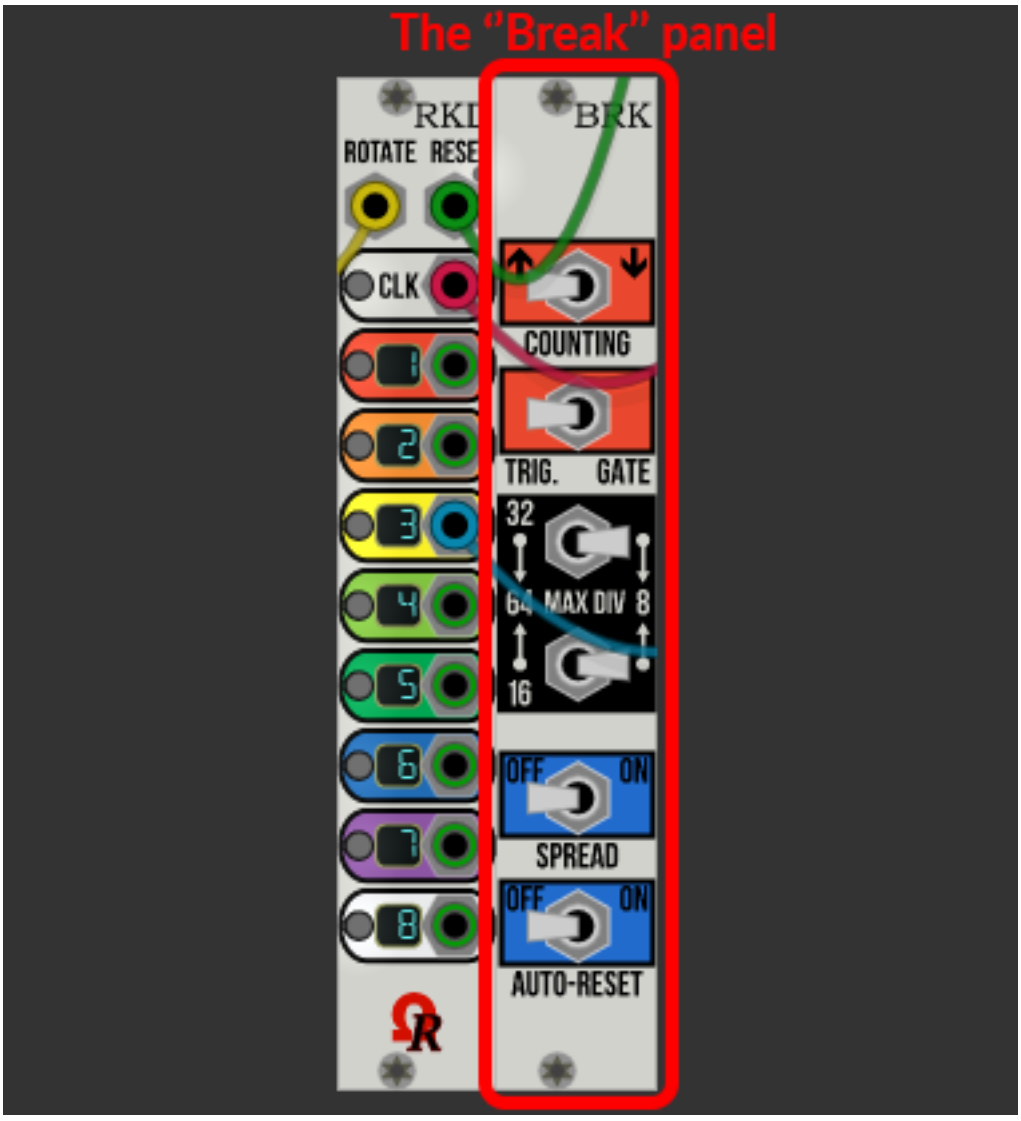
Also, RKD module provides some indicators, for the user (you), like:

- A tiny "tri-colored" LED near RESET jack (each color have its signification, explained later).
- White rounded LED, alongside CLK input jack, blinking on incoming clock pulses.
- 8 colored round LEDs, alongside 1+R, 2+R, 3+R, 4+R, ... 7+R and 8+R output jacks.
- Two-digit (cyan) segment-LED display, belongs each output jack.

All indicators will be described, later in this manual.

MODULE LAYOUT (RKD with "Break")

Typically a RKD module, plus a ***companion*** panel that hosting **six switches**:



The "Break" panel, also named "BRK", doesn't embed indicators (nor electronic components), it doesn't need power source (passive panel).

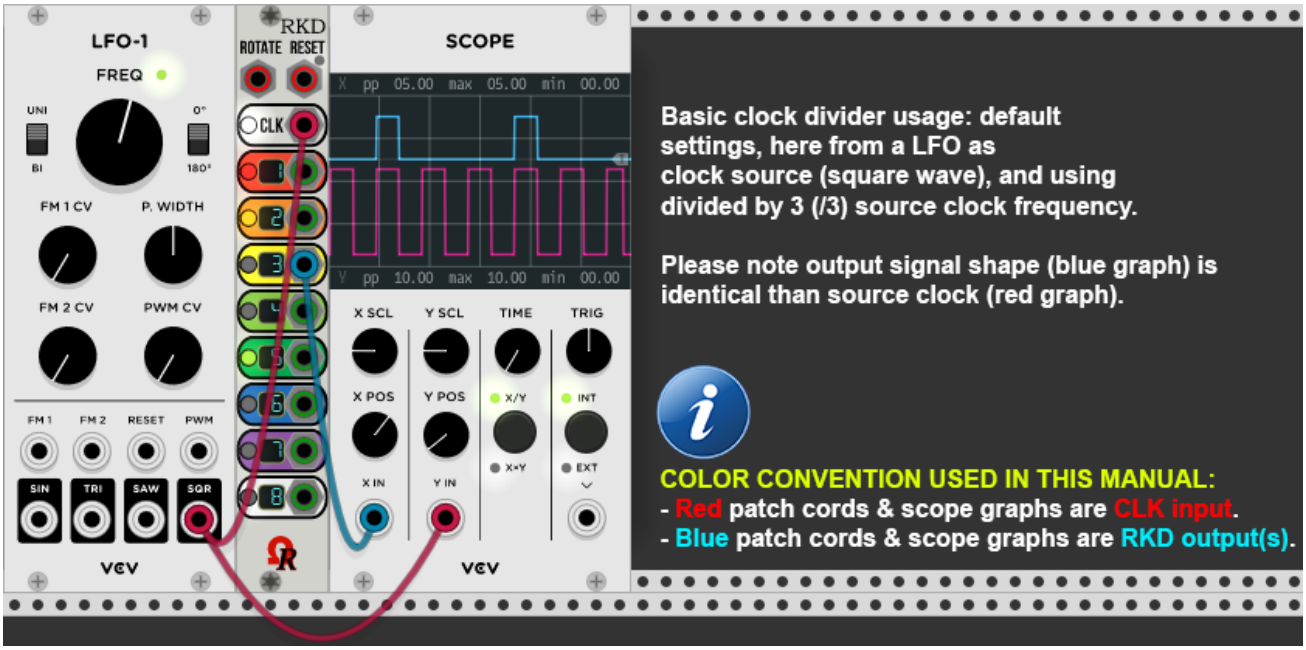
KEY FEATURES

- Support source clock (CLK) signal. Trigger @+3.5V (rising edges), any waveform.
- 8 output jacks, CLK-divided from 1 upto 64, trigger (default) or gate outputs (+5V).
- Up-beat (default) or down-beat counting mode (for both trigger / gate mode).
- Segment-LED displays, near each output jack, displaying current dividers (in real-time).
- ROTATE input jack (0V ~ +5V CV-based) to "rotate" dividers along all output jacks.
- 5 dividers tables (can be choosen via context-menu). "Manufacter" is always default.
- Optional "spread" dividers (only applicable for "Manufacturer" dividers table).
- Buffered RESET input jack (trigger @+3.5V on rising edge, retrig @+0.2V on falling edge).
- Optional "Auto-Reset" feature, useful to re-synchronize "weird" dividers to current tempo.

BASIC USAGE OR... HOW TO DIVE QUICLY INTO "RKD" WORLD!

Like static clock modulator devices, both RKD module is ready to use (as-is) when added in your rack. Each output jack provides different dividers, so this will offer many choices.

This is an example of basic module usage (untouched default setting, not patched CV):

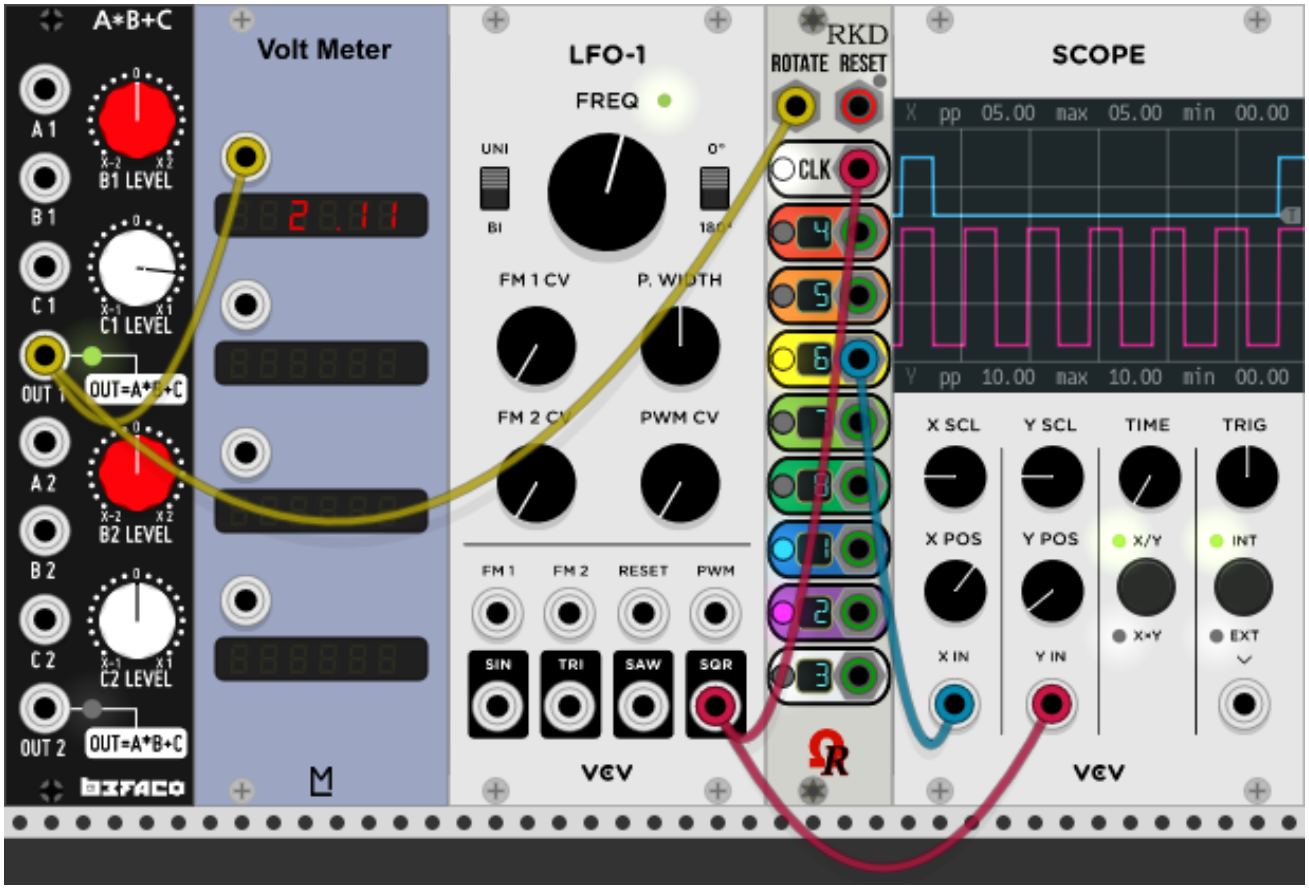


Another tip: if case your rack needs a "native" divider (as default/base, without CV usage), perhaps you'll can find it, by trying different built dividers tables (via context-menu).

For example, your rack needs **/64** to reset/re-sync many sequencers. Fortunately, you're a lucky guy, because you'll can find this divider from both **Perfect squares** or **Triplet & 16ths** dividers tables. Then, by patching **"8+R" output jack** to your slave sequencers... Easy, arent?

Of course, you was lucky to have got a native divider, quickly! Sometimes, it will may more difficult in case you'll need rare, or "weird" (exotic) divider, such **/29**, **/37**, **/53**... but...

...ROTATE jack is your buddy! by applying a **static voltage** on ROTATE jack (from 0V to +5V, by voltage thresholds), this will change all dividers on every output jack:



Example above uses constant **+2.11V** control voltage, applied on ROTATE jack (yellow patch cord). provided by Befaco's **A*B+C** module, and confirmed by ML's **Volt Meter**.

You'll can notice all dividers have been changed, as indicated by their segment-LED displays, so the previously used "3+R" output jack have "moved" from **/3** to... **/6**. Bingo!

This behavior is called **TABLE ROTATION**, or more usualy: **ROTATION**.

Valid CV range for ROTATE jack is 0V to +5V.
Negative voltage (or disconnected) is assumed as 0V by RKD module firmware.
Also, voltages over +5V are always assumed equal to +5V (hard clipping).

Obviously, it's a simple situation, because the control voltage applied on ROTATE input jack, is static. By this way, all dividers for output jacks remain unchanged while this CV is held.

It's an easy trick to use any custom clock divider you'll want for your rack!

Instead of to use a "static" voltage on ROTATE jack (static dividers on RKD), you'll can use dynamic voltages, instead, generated from CV-based sequencer, oscillator, LFO, envelope generator, random noise, sample, or any source voltage you'll want, in fact, the unique condition is 0V / max. +5V voltage range.

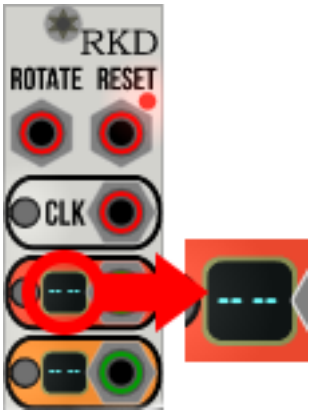
RKD module may become a powerful weapon for your rack and for... creativity!

About table rotation, you'll can find details about dividers tables, and their possible rotations, later in this manual.

Obviously, you'll can combine many RKD modules together, by chaining them, one output jack patched to CLK jack on another. In fact... depending your needs!

Common strange behavior have been reported by some users, on social networks:
The infamous "-- --" signs on all jack displays. Why?

RKD module requires a source clock to operate, patched on its CLK input jack. In case the CLK jack isn't connected, all dividers displays are showing "-- --", and small LED near RESET jack is lit red color, indicating error condition:



RESET LED behaviors will be detailled later in a specific chapter.

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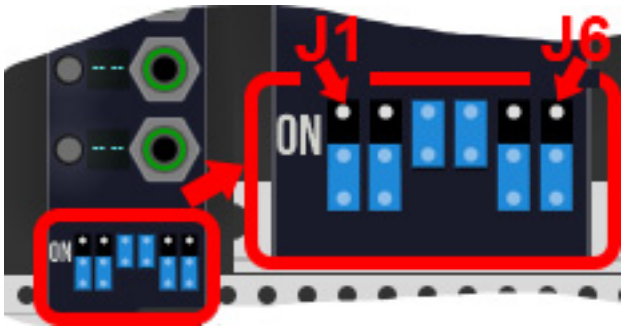
JUMPERS (RKD MODULE ONLY)

RKD module is more thin (4 HP) than "RKD with Break" (twice width) module, because it doesn't embed the (six) switches. Exactly like existing Eurorack hardware equivalent, you'll must remove the RKD module away from rack (without disconnecting cable) in order to access to six jumpers (shunts), located on module's PCB (printed circuit board).

Do a right-mouse button click over RKD module, then select **View jumpers (located on PCB)** from context-menu (see image page 2). Now the module becomes "nude like a worm" ;) and now you'll can discover, at the bottom of module, six blue shunts, called "jumpers".

To change jumper position, simply click it (left-mouse button). Each jumper acts as On/Off (toggle) switch. Certain setting needs the jumper is installed (On/up position), or removed (Off/down position). Each jumpers is named **J1** to **J6**, from left to right:

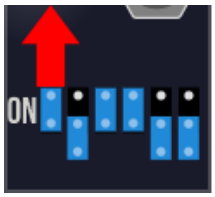


Jumper	Feature	Position	Behavior description	
J1	Counting	ON	Down-beat counting.	
		OFF	Up-beat counting (default).	
J2	Trig. / Gate	ON	All jacks output gates.	
		OFF	All jacks output triggers (default).	
J3	Max Div 16	ON	Max. divider may be 8 (J4=On) or 16 (J4=Off).	Default: 8
		OFF	Max. divider may be 8 (J4=On) or 64 (J4=Off).	
J4	Max Div 32	ON	Max. divider may be 8 (J3=On) or 32 (J3=Off).	
		OFF	Max. divider may be 8 (J3=On) or 64 (J3=Off).	
J5	Spread	ON	Spread on (applicable on manufacturer table only).	
		OFF	Spread off/disabled (default).	
J6	Auto-Reset	ON	Auto-Reset fired every "Max Div" x 2 clocks.	
		OFF	Auto-Reset off/disabled (default).	

Jumpers J3 & J4 are working together, offering four maximum divider (Max Div) possibilities. These jumpers (and switches equivalent on BRK panel) are used only for "Manufacturer" dividers table (ignored for extra tables like "Primes numbers", "Fibonacci sequence", etc.)

UP-BEAT VS. DOWN-BEAT COUNTING

Default (factory), **counting** is set to **up-beat counting**, but can be changed to **down-beat counting**, instead, either by installing (On) **J1 jumper** (RKD module), or by changing **COUNTING switch** to right position, from BRK panel (position indicated by "down arrow"):



Setting for down-beat counting.

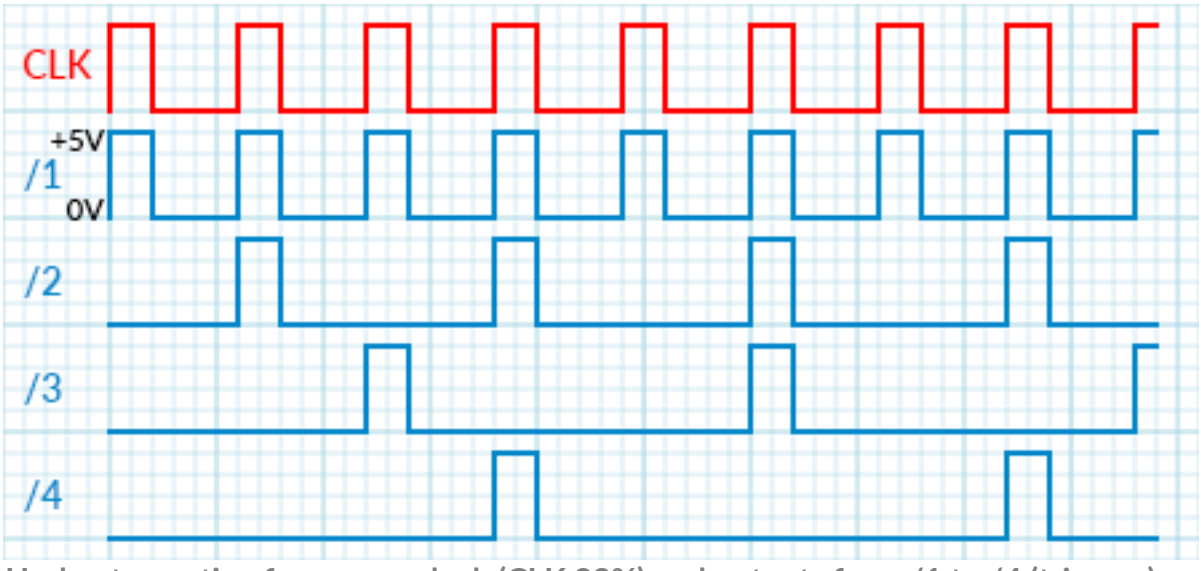
For the following explanations, **N** stands for current ***DIVIDER*** used by (specific) output jack. Also, **C** may be used to indicate pulse ***COUNTER*** (number of **C**LK).

UP-BEAT COUNTING

Relevant output jack will start to fire (from the first time) after **N** counted clock pulses (C=N). Then, it will continue to fire on every **C** incoming CLK pulses...

	Incoming CLK pulses (outputs are always fired on CLK rising edges)																													
Divider (N)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
/1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
/2		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X
/3			X			X			X			X			X			X			X			X			X				
/4				X				X				X				X				X				X				X				X
/5					X					X					X					X				X					X		
/6						X						X						X						X						X		
/7							X							X							X							X				
/8								X								X								X								X

Up-beat counting table (each "x" represent a firing output jack).



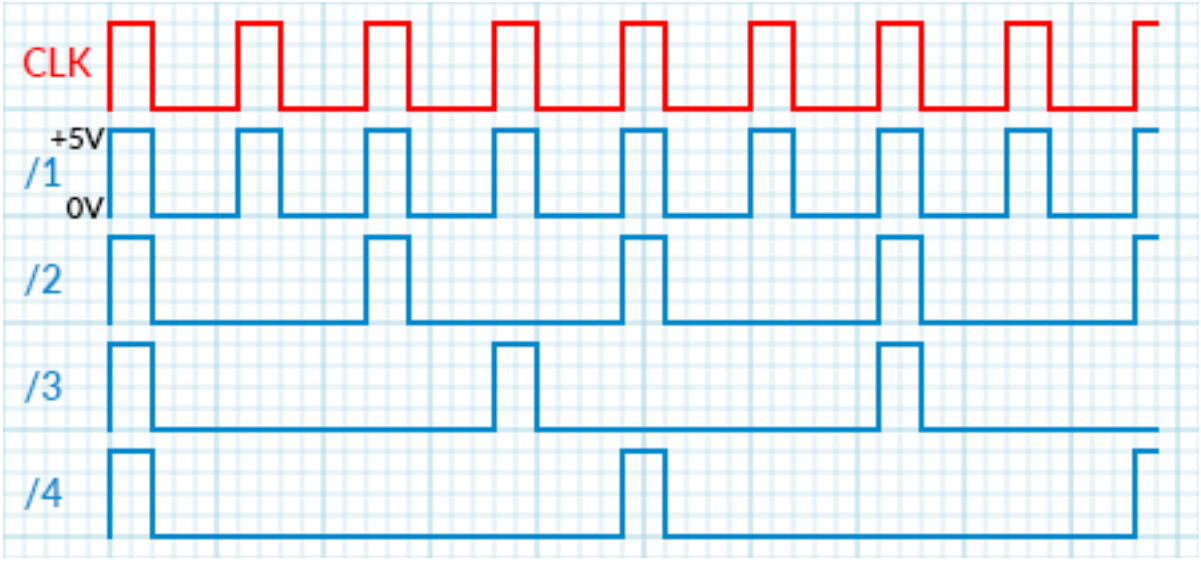
Up-beat counting for source clock (CLK 33%) and outputs from /1 to /4 (triggers).

DOWN-BEAT COUNTING

As alternative, ALL output jacks fire **immediatly on FIRST clock pulse** (at **C=1**, for example as soon as source clock starts to pulse). This is called the **early first** clock pulse.
Then, each concerned jack (separately) continues to fire on every **N** incoming CLK pulses...

	Incoming CLK pulses (outputs are always fired on CLK rising edges)																													
Divider (N)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
/1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
/2	X		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X	
/3	X			X			X			X			X			X			X			X			X			X			X	
/4	X				X				X				X				X				X				X				X			
/5	X					X					X					X					X					X				X	
/6	X						X						X						X						X						X	
/7	X							X							X							X							X			
/8	X								X								X								X							

Down-beat counting table (each "x" represent a firing output jack).



Down-beat counting for source clock (CLK 33%) and outputs from /1 to /4 (triggers).

In down-counting, the main difference is all 8 jacks are firing together, on early first clock pulse (received by RKD module, at C=1), then the process continues exactly like "up-beat" does, any output (except **/1**) is delayed (or defered) at "C+1", instead!

In some circumstances, down-beat counting may be is useful at start of sequence, for example to synchronize all devices connected behind a RKD module, thanks to simultaneous output signals!

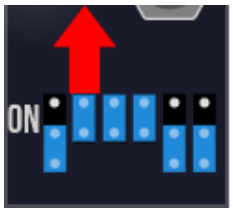
Graphs used to describe both up-beat and down-beat counting behaviors are based on "trigger" digital signals, for best explanations,

You'll can observe, for **/1** output jack, they're absolutely no difference between up-beat and down-beat counting!

TRIGGER VS. GATE

RKD modules are able to output either triggers or gates. Previously, in up-beat and down-beat counting explanations, both graphs show triggers.

Default (factory) is always set to trigger, but can be changed to **gate**, instead, either by installing (On) **J2 jumper** (RKD module), or by changing **TRIG. GATE switch** to right position, from BRK panel ("GATE" position):



Setting for gate mode (instead default "trigger").

Depending you needs, you'll use triggers for short-duration pulses, for example to control basically a sequencer, to trigger drum, Bernoulli gate, clock modulator, or "trigger & forget"-type devices.

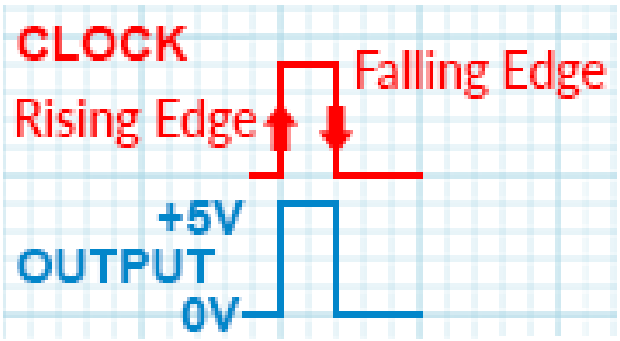
Instead, other situations may require a sustained (held) voltage - held during a certain time. The most common usage is to control the sustain (S) stage of ADSR envelope generator. Held voltage during a longer time are designed as "gates".

TRIGGER

When RKD module is set as "trigger" (TRIG.), any output always have exactly the same waveform than souce clock (like illustrated by graphs, pages 8 and 9, and below).

Any output is always fired (+5V) on incoming clock pulse (+3.5V or more, as "trigger voltage" received on its CLK input jack). Incoming clock pulse events are named... **rising edges**.

Fired outputs are held at +5V, until source clock voltage falls under +0.2V.
These events, when source voltage is falling, are named... **falling edges**. Easy, arent?



GATE

Gate concepts proposed by RKD modules are a bit difficult to explain (but not too difficult to understand, however), because they're many possible scenarios!

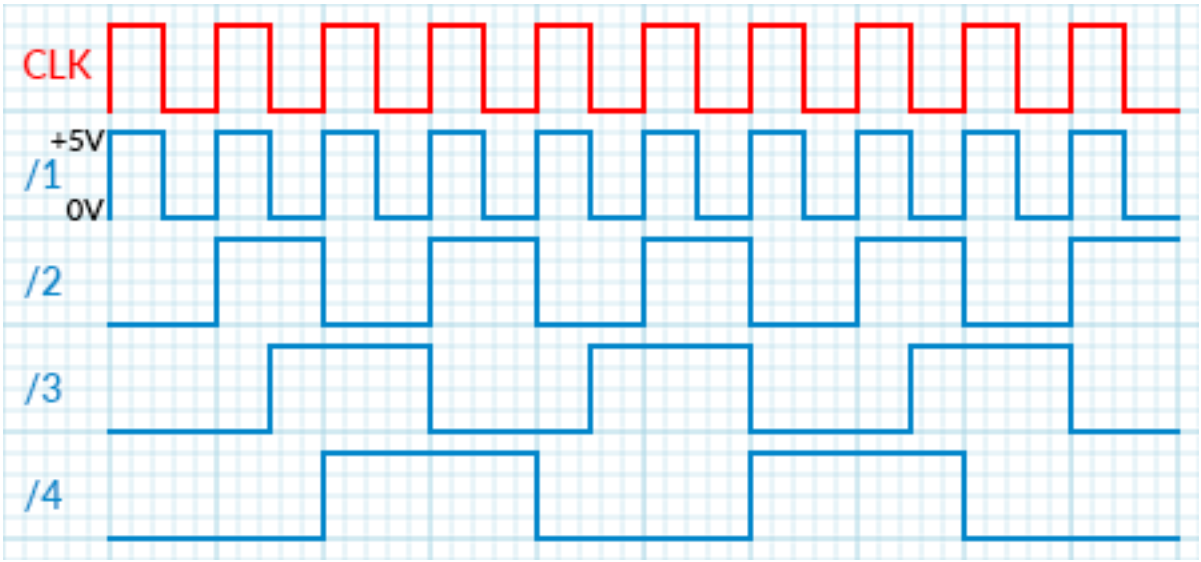
Firsly, concerning **/1** output jack, they're no difference between trigger and gate!
/1 output jack always follows source **CLK** waveform.

Principle of gates is based on "output state inversion" (like an on/off switch does):

- from 0V to +5V (output rising edge), when output state is low (0V).
- from +5V to 0V (output falling edge), when output state is high (+5V).

Like trigger does (as described in previous pages), gate can be combined together with up-beat or down-beat counting. You've the choice, **so you're the Boss**, you'll decide! ;)

The following graph shows how gates are triggered (and sustained) when the source CLK is a square wave (50%), **up-beat counting** (factory), from **/1** to **/4** output jacks:



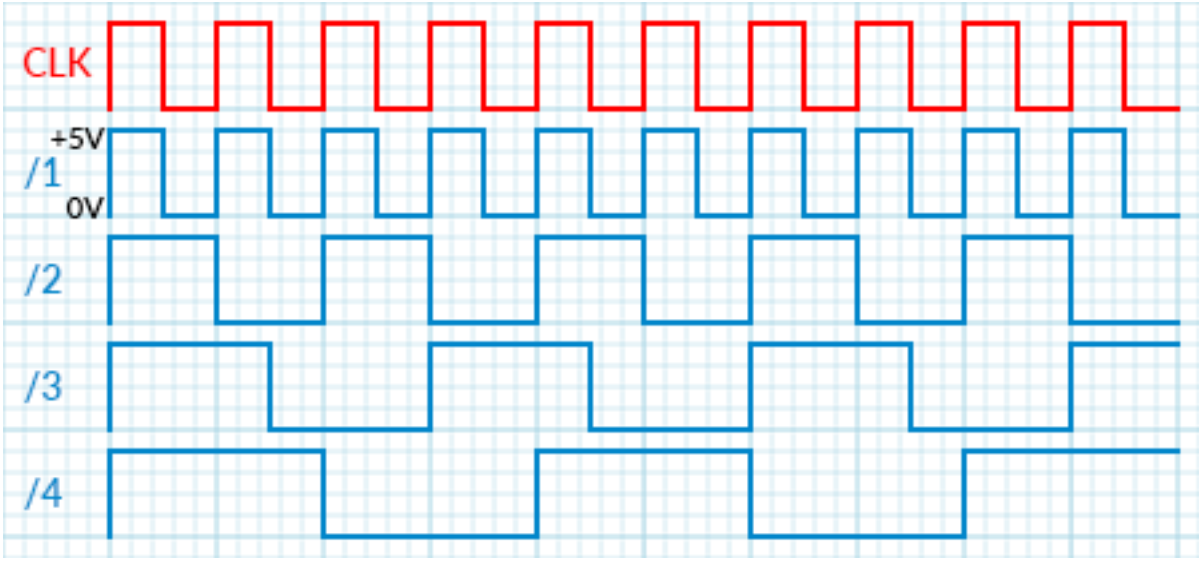
Up-beat counting for square source clock (CLK 50%) and outputs from /1 to /4 (gates).

You'll can observe, for **/3**, the output state changes once on CLK falling edge, then once on CLK rising edge, alternatively. **This technique is called "2.5".**

This rule is true for any odd divider. Also valid for **/1**, as... odd divider.

By the same way, for even dividers, you'll can see all state changes are always done during CLK rising edge only.

The following graph shows how gates are triggered (and sustained) when the source CLK is a square wave (50%), but **up-beat counting**, from **/1** to **/4** output jacks:

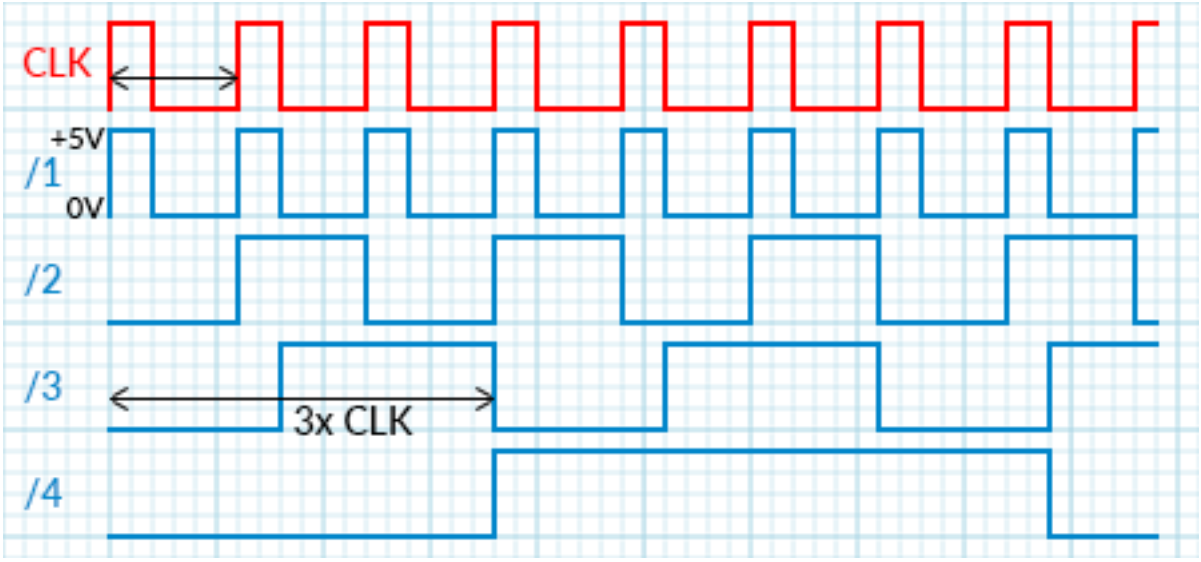


Down-beat counting for square source clock (CLK 50%) and outputs from /1 to /4 (gates).

Except for output /1, as usual (remember output **/1** is always a replicated CLK signal, unaltered, in all circumstances), in down-beat counting, all gates are... inverted!

Okay, but for previous "gate" scenarios (up-beat and down-beat counting), we was living into an ideal world, I mean... by using a square (50%) waveform source clock. But some clock generator modules don't offer a square, like **BPM Tools**, by AS, sending 25% gate, also valid for other clock sources (KlokSpid can output fixed-duration pulses, or many gate-based patterns).

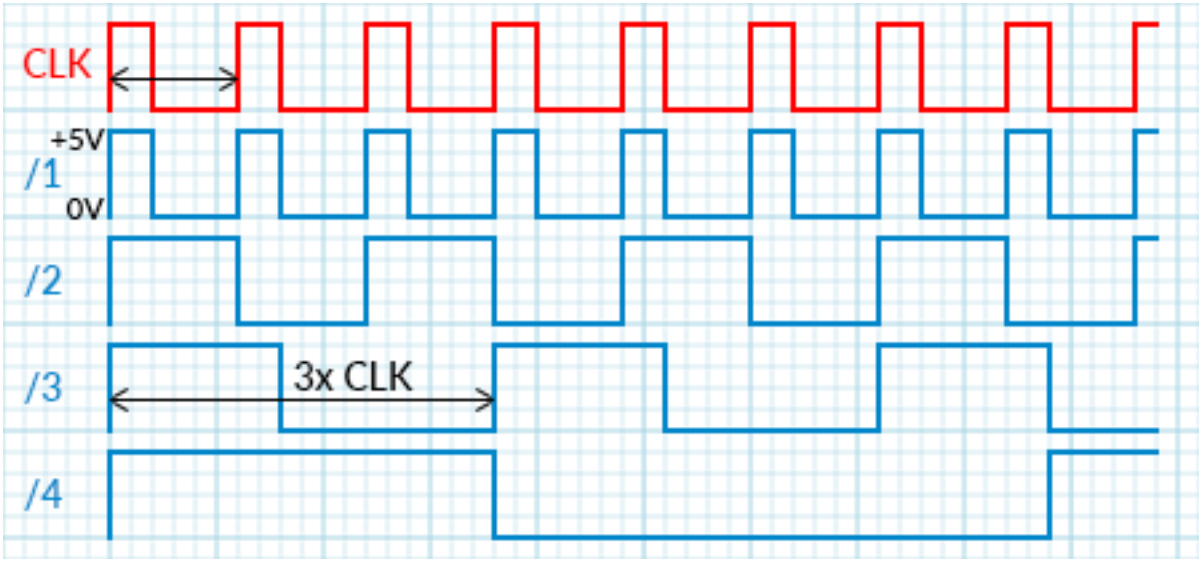
Following graph shows how gates are triggered (and sustained) when the source CLK is 33% (1/3 high-state, 2/3 low-state), **up-beat counting** (factory) again, from **/1** to **/4** output jacks:



Up-beat counting for square source clock (CLK 33%) and outputs from /1 to /4 (gates).

As you'll can see, principle remain identical, but for /3, state durations are... 33% low, followed by 66% high-state. This technique permits to use any waveform source clock.

Now the same source clock (33%), but **down-beat counting**, combined with **gate** mode:



Down-beat counting for square source clock (CLK 33%) and outputs from /1 to /4 (gates).

MAX DIV

Max Div stands for **maximum divider amount**: used mainly on "Manufacturer" dividers table, it's virtually defines the maximum possible divider for a given output jack (depending current table rotation). RKD module uses two "linked" jumpers, **J3** and **J4** (by default, both are On): By using two jumpers together, this will offer 4 possible "Max Div" values:

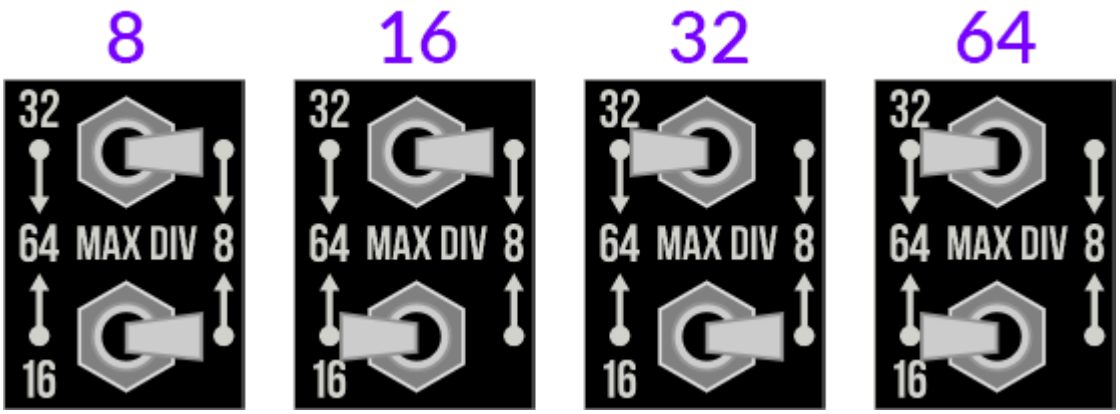
J3	J4	Jumpers view	Max Div
ON	ON		8 (default)
ON	OFF		16
OFF	ON		32
OFF	OFF		64

However, other built-in dividers tables, such **Prime numbers**, **Perfect squares**, **Fibonacci sequence** and **Triplet & 16ths**, always use default "Max Div" 64 (whatever jumpers/switches setting), and **can't be changed**. "Prime numbers" dividers table sometimes can use "Max Div" 32 instead, regardling the greatest divider used by "J+8" output jack. These operations, for extra dividers tables only, are always done automatically by module's firmware.

Like any other jumpers, you'll can change them anytime you want. However, new "Max Div" value becomes effective **on next CLK pulse** (rising edge, received by RKD module).

Concerning **RKD with "Break"** module, it's more easy to select (and to read) the current "Max Div" setting, via two switches located into black serigraphy section of the BRK panel.

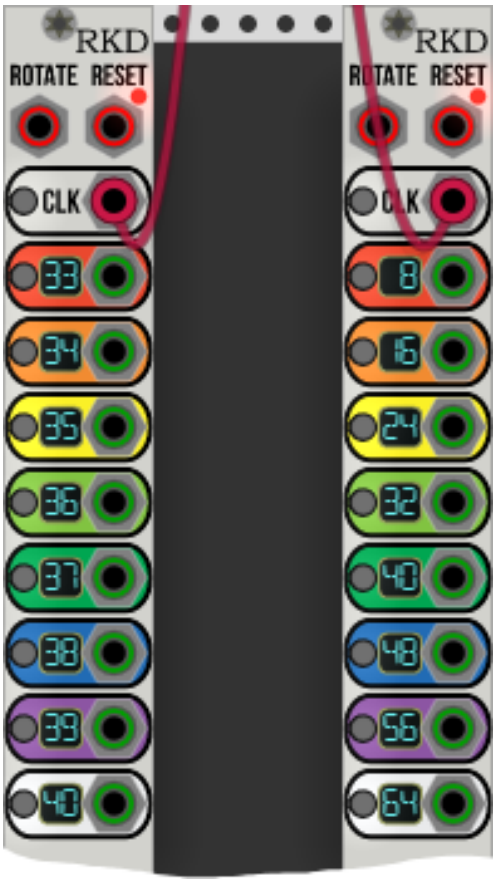
Values indicated at middle (left and right sides) concern **same position for both switches**.
By this way, both placed at left position means Max Div 64.
Both placed at right position means Max Div 8 (it's the default setting).



Possible "Max Div" settings, via switches on "BRK" panel.

SPREAD

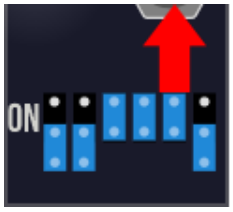
Also dedicated to "Manufacturer" dividers table exclusively (and by this way, ignored when extra dividers table is in use, instead), when spread setting is "On", dividers are spread over all output ports, regardling the current "Max Div" setting.



Spead off (left RKD) vs. on (right), both "Manufacturer" dividers table, "Max Div" 64.

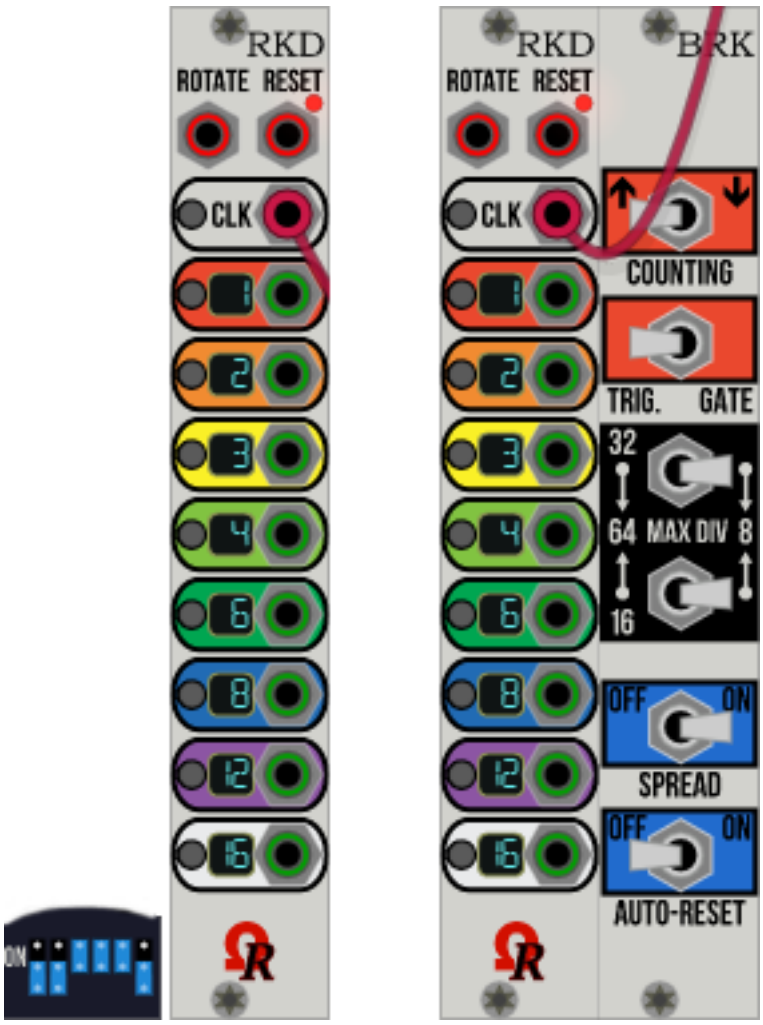
You can observe, on right RKD module (displays), used dividers are "spread" amongst the full "Max Div" (illustrated example in previous page shows Max Div set to 64).

Default (factory) is always set to **spread off** but can be changed to **spread on**, instead, either by installing (On) **J5 jumper** (RKD module), or by changing **SPREAD switch** to right position, from BRK panel ("ON" position):



Setting for spread on.

One of lovely feature will occur when "Max Div" is set to default 8 (jumpers J3 & J4 are on/installed, or both MAX DIV switches are set at right position from "BRK" panel), coupled with "Spread" set to On (jumper/switch position shown just above): in this case, all dividers become **musical-based**, like **triplets** (/3, /6, and /12) and **sixteenths** (/2, /4, /8, and /16). This particular situation implies the "Max Div" is automatically set as 16, instead of 8 (done by the module's firmware).



Spead on, together with "Max Div" set to 8, gives... musical-based dividers.

AUTO-RESET

(to be continued)...

This "User's Guide" remains...