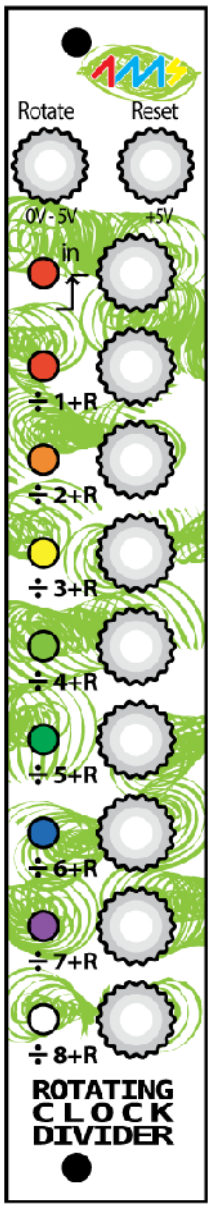


Rotating Clock Divider

Eurorack Module User Manual v1.0.1 to 1.0.2

4ms Pedals

Features

•Divide-by-1 to Divide-by-64, on 8 output jacks

•CV Rotate jack to shift divide-by amount on all jacks

•CV Reset to reset/re-sync all jacks

•Jumpers or optional break-out panel:
- ◦ Select auto-reset (maximum 256 clocks)
- ◦ Select maximum divide-by amount (8/16/32/64)
- ◦ Gate or Trigger outputs
- ◦ Count-up or Count-down mode

•UART header
- ◦ Connects to optional MIDI breakout panel
- ◦ Arduino-compatible

•ISP header
- ◦ Connects to in-circuit programmer such as AVR ISP MKII for reprogramming code

•Maximum input frequency 3kHz

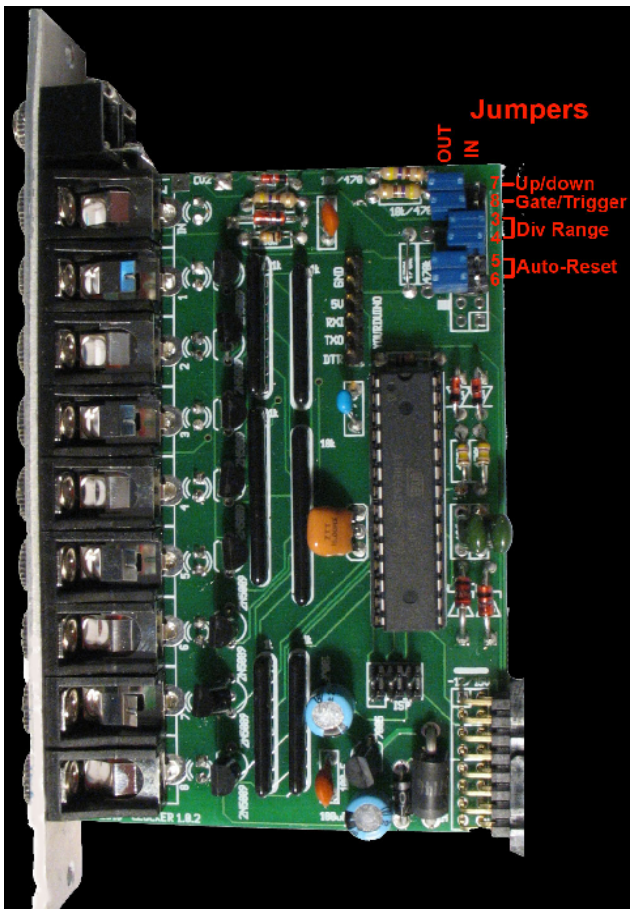
•4 H.P. Eurorack module

•60mA power draw (+/-12V or +/-15V)

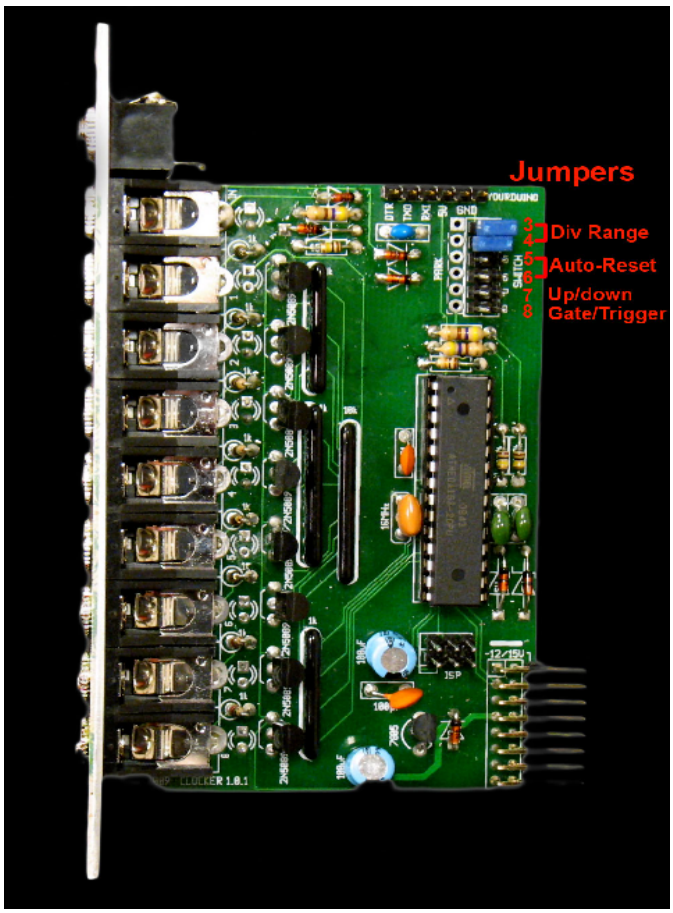
Jacks

- Clock Input (3.5V to 15V clock, rising edge triggered)
- CV Rotate (0V to +5V input)
- CV Reset (5V to 15V trigger)
- Divided Clock Outputs (8 jacks):
  - Divide-by (1+R)
  - Divide-by (2+R)
  - Divide-by (3+R)
  - Divide-by (4+R)
  - Divide-by (5+R)
  - Divide-by (6+R)
  - Divide-by (7+R)
  - Divide-by (8+R)

  ...where R is the CV Rotation (0 to 63)



PCB v1.0.2



PCB v1.0.1

Jumpers

There are six jumpers on the back, labeled 3, 4, 5, 6, 7, and 8. Each can be set with a jumper plug, or an optional break-out panel with switches. The jumper positions vary among PCB versions. See the above photos to identify the location of jumpers on your PCB (the PCB version is written in white letters near the /8 Jack).

Jumpers 3 and 4: Max Divide-by Range

Div Range Jumpers		Total Rotatable Divide-by range	Divide-by amount on jacks with no voltage applied to CV Rotate Jack (tables 2-5)
3	4		
in	in	1 to 8	1 to 8
in	no	1 to 16	9 to 16
no	in	1 to 32	17 to 24
no	no	1 to 64	33 to 40

Jumpers 5 and 6: Auto-reset

Auto-Reset Jumpers		Auto-reset with Divide-by range of...			
5	6	1 to 8	1 to 16	1 to 32	1 to 64
in	in	32	64	128	256
in	no	16	32	64	128
no	in	24	48	96	192
no	no	none	none	none	none

Jumper 7: Up-beat/Down-beat counting

Up/Down	Mode
in	Down-beat counting
no	Up-beat counting

Jumper 8: Gate/Trigger mode

Gate/Trigger	Mode
in	Gate mode
no	Trigger mode

Up-beat/Down-beat jumper:

In Up-beat counting, each jack fires after "N" number of pulses are counted on the input jack (where N is the divide-by-number). So, after a Reset pulse, only the /1 jack will fire on the first clock pulse. On the next clock pulse, the /1 and the /2 jack will fire, then on the next pulse the /1 and /3 jacks will fire, etc... This is the default method for pcb v1.0 and v1.0.1, unless it has been upgraded to v1.0.2 code.

In Down-counting, each jack fires when its count is 1. So all the jacks will fire after a Reset pulse, and then count up to "N", and fire again when they start over at 1. This is called" down-beat counting" because all the jacks fire on the down-beat (first clock pulse).

Gate/Trigger Mode jumper:

In Trigger mode, the jacks output a pulse width equal to that of the input clock (the pulse width is not multiplied or divided proportionally to the jack's divide-by amount). This is the default method for pcb v1.0 and v1.0.1, unless it has been upgraded to v1.0.2 code.

In Gate mode, the width of the output pulses are 50% of the total wave. For example, the /6 jack will stay ON for 3 clock pulses, and then turn OFF for 3 clock pulses. For even numbered divisions (/2, /4, /6, /8, etc) the transitions happen on the input clock's rising edge.

Point of interest: In Gate mode, with odd-numbered divisions, the jack will turn ON on a rising edge of the input clock, and then will turn OFF on a falling edge. For example, the /5 jack ought to stay on for 2.5 clock pulses, meaning it should go OFF somewhere between the rising edge of clock pulses 2 and 3. Right in between these is the falling edge of pulse number 2, so we can safely call it 2.5!

When in Gate mode (jumper 8), the difference between Up-counting and down-counting is simply that the gates are inverted.

Auto Reset jumpers:

Jumpers 5 and 6 select the Auto-reset point, which causes the divide counters to reset after a certain number of clock pulses. Note that divide-by amounts which are evenly divisable by the reset amount are not affected: e.g. with an auto-reset of 16, divide-by outputs of 2, 4, 8, 16, etc are not changed.

Also, note that the CV Reset is independant of the Auto-reset. For example, Jack 7+R could be patched into the CV Reset with jumpers 3, 4, and 5 in. This would cause a reset every 7 clocks, plus an additional reset every 16 clocks.

There are too many combinations of Auto-reset and Max divide amounts to show all combinations!

Example: Auto-reset of 16 (Jumper 5 in, no Jumper 6), with Max Divide-by of 8 (Jumpers 3&4)

IN:	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
3			X			X			X			X			X				X			X			X			X			X	
5					X					X					X						X					X					X	
7							X							X									X							X		

Operation

Apply a clock signal to the Clock Input jack. Rising edges of 5V or greater will cause the internal dividing counters to be incremented. Each jack has its own counter that counts from 1 to its divide-by-amount, and then resets back at 1. In up-beat counting, each jack outputs a trigger pulse when its counter reaches the divide-by amount assigned to that jack. In down-beat counting, each jack fires when its counter is 1. Typically, the outputs will patch to trigger-able or gate-able modules (drum modules, ADSR envelope/transient generators, step sequencer clock input, etc..), but the RCD can also operate in the audio frequency range, thus crudely stepping pitch downward.

Clock outputs (up-beat counting):

IN:	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		
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
9									X									X									X					
10										X										X									X			
11											X											X										
...																																
32																																X

Clock outputs (down-beat counting):

IN:	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										
8	X								X								X								X							

CV Rotation

By applying a CV signal to the CV Rotate jack, the clock divisions will rotate throughout the output jacks (*see table 2*). For example, if you apply just over 1.0V, Jack 1+R/Red will go from Divide-by-1 to Divide-by-2, and Jack 2+R/Orange will become Divide-by-3... up to Jack 8+R/White which will wrap ("rotate") around to become Divide-by-1. Applying more CV to the Rotate Jack will continue the rotation: next Jack 1 becomes Divide-by-3, then Divide-by-4, then Divide-by-5, until it's Divide-by-8 at the maximum input CV. Some non-linearities exist in the CV response, especially in the upper extreme. ***See diagram at end of this manual.***

CV Reset

Applying a CV of 5V or greater to the CV Reset jack will cause all the divide counters to reset **on the next clock pulse**. So, applying a reset pulse will not change the tempo, since the RCD will wait for the next clock pulse to actually do anything. Counting will begin back at 1 after a Reset. A low/slow output on the RCD can be patched into Reset, or a second RCD running on the same master clock can be set to run very slow and reset the first RCD after an arbitrary number of beats.

Rotation Tables

Table 2: Divide-by amounts at each jack, with max divide-by amount set to 8 (Jumper 3 in, Jumper 4 in):

Jacks	Voltage at CV Rotate Jack							
	<1.0V	1.00V - 1.65V	1.65V - 2.30V	2.30V - 2.95V	2.95V-3.60V	3.6V-4.30V	4.30V-5.10V	>5.1V
1+R/Red	1	2	3	4	5	6	7	8
2+R/Orange	2	3	4	5	6	7	8	1
3+R/Yellow	3	4	5	6	7	8	1	2
4+R/Lt Green	4	5	6	7	8	1	2	3
5+R/Green	5	6	7	8	1	2	3	4
6+R/Blue	6	7	8	1	2	3	4	5
7+R/Violet	7	8	1	2	3	4	5	6
8+R/White	8	1	2	3	4	5	6	7

Table 3: Divide-by amounts at each jack, with max divide-by amount set to 16 (Jumper 3 in, no Jumper 4):

Jacks	Voltage at CV Rotate Jack															
	< 0.7V	0.7V - 1.0V	1.0V - 1.3V	1.3V - 1.7V	1.7V - 2.0V	2.0V - 2.3V	2.3V - 2.7V	2.7V - 3.0V	3.0V - 3.3V	3.3V - 3.7V	3.7V - 4.0V	4.0V - 4.3V	4.3V - 4.7V	4.7V - 5.1V	5.1V - 5.8V	> 5.8V
1+R/Red	9	10	11	12	13	14	15	16	1	2	3	4	5	6	7	8
2+R/Orange	10	11	12	13	14	15	16	1	2	3	4	5	6	7	8	9
3+R/Yellow	11	12	13	14	15	16	1	2	3	4	5	6	7	8	9	10
4+R/Lt Green	12	13	14	15	16	1	2	3	4	5	6	7	8	9	10	11
5+R/Green	13	14	15	16	1	2	3	4	5	6	7	8	9	10	11	12
6+R/Blue	14	15	16	1	2	3	4	5	6	7	8	9	10	11	12	13
7+R/Violet	15	16	1	2	3	4	5	6	7	8	9	10	11	12	13	14
8+R/White	16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Table 4: Divide-by amounts with max divide-by amount set to 32 (Jumper 3 out, Jumper 4 in):

Jacks	Voltage at CV Rotate Jack															
	< 0.5V	0.68V	0.86V	1.04V	1.22V	1.38V	1.54V	1.70V	1.86V	2.02V	2.18V	2.36V	2.52V	2.68V	2.82V	3.00V
1+R/Red	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
2+R/Orange	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	1
3+R/Yellow	19	20	21	22	23	24	25	26	27	28	29	30	31	32	1	2
4+R/Lt Green	20	21	22	23	24	25	26	27	28	29	30	31	32	1	2	3
5+R/Green	21	22	23	24	25	26	27	28	29	30	31	32	1	2	3	4
6+R/Blue	22	23	24	25	26	27	28	29	30	31	32	1	2	3	4	5
7+R/Violet	23	24	25	26	27	28	29	30	31	32	1	2	3	4	5	6
8+R/White	24	25	26	27	28	29	30	31	32	1	2	3	4	5	6	7

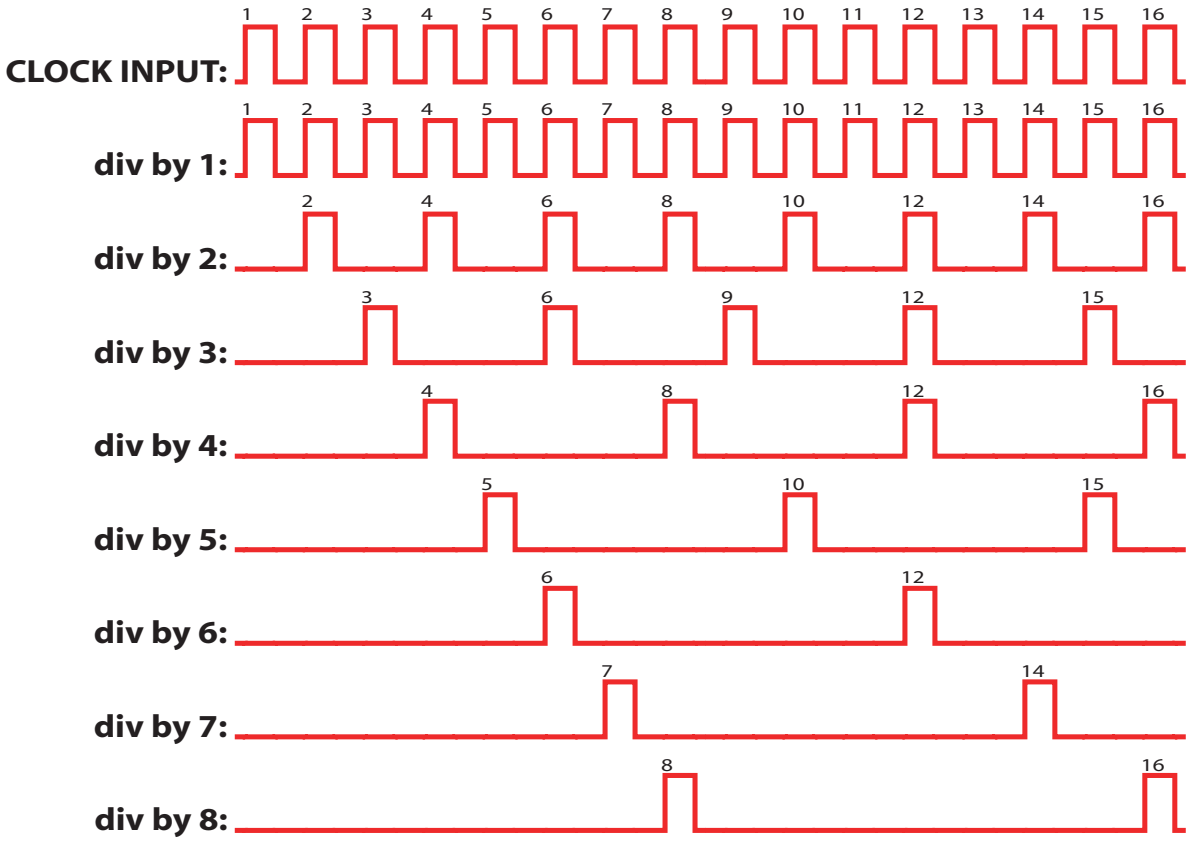
(con't)	3.18V	3.34V	3.50V	3.68V	3.82V	4.00V	4.18V	4.36V	4.54V	4.72V	4.94V	5.17V	5.43V	5.80V	6.52V	> 6.52V
1+R/Red	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
2+R/Orange	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
3+R/Yellow	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	1
4+R/Lt Green	19	20	21	22	23	24	25	26	27	28	29	30	31	32	1	2
5+R/Green	20	21	22	23	24	25	26	27	28	29	30	31	32	1	2	3
6+R/Blue	21	22	23	24	25	26	27	28	29	30	31	32	1	2	3	4
7+R/Violet	22	23	24	25	26	27	28	29	30	31	32	1	2	3	4	5
8+R/White	23	24	25	26	27	28	29	30	31	32	1	2	3	4	5	6

Table 5: Divide-by amounts at each jack, with max divide-by amount set to 64 (no Jumper 3 or 4)

Jacks	Voltage at CV Rotate Jack															
	< 0.5V	0.68V	0.86V	1.04V	1.22V	1.38V	1.54V	1.70V	1.86V	2.02V	2.18V	2.36V	2.52V	2.68V	2.82V	3.00V
1+R/Red	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
2+R/Orange	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
3+R/Yellow	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
4+R/Lt Green	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
5+R/Green	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
6+R/Blue	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
7+R/Violet	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
8+R/White	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55

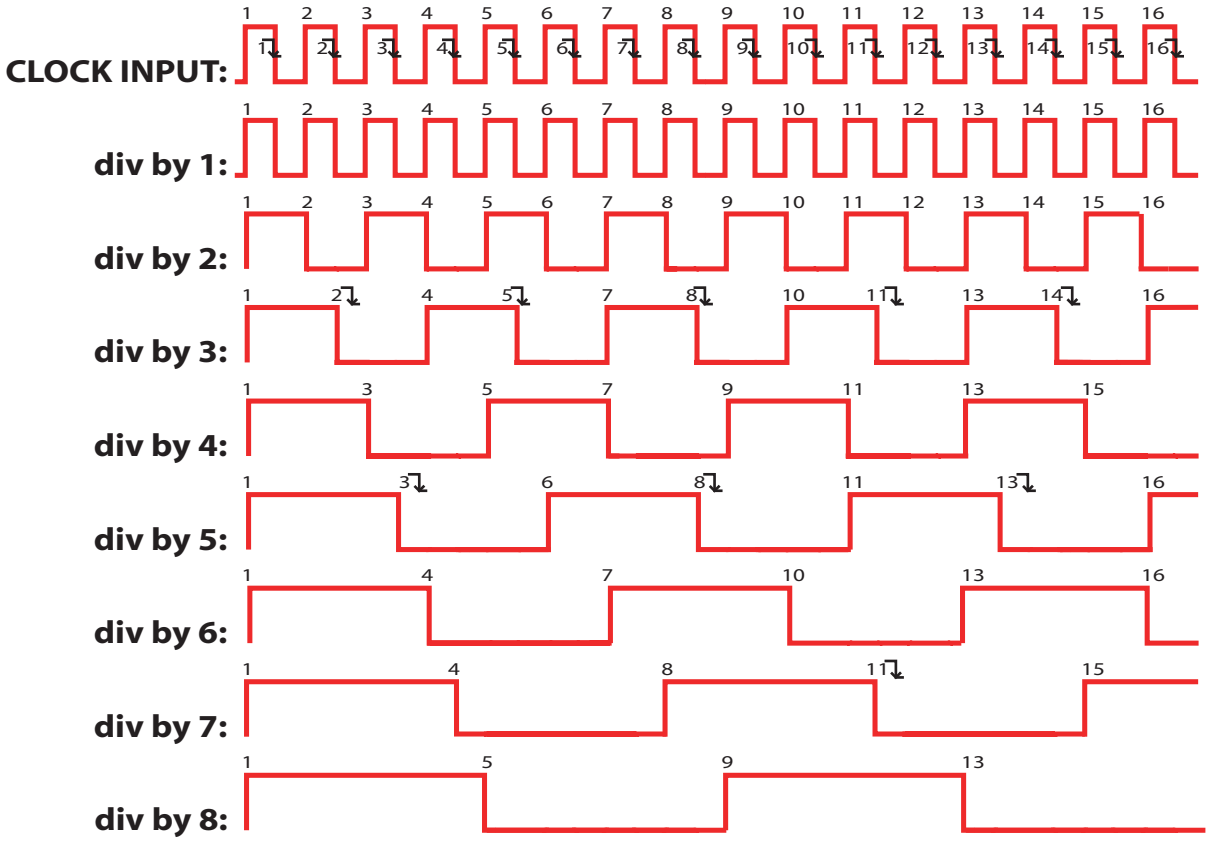
(con't)	3.18V	3.34V	3.50V	3.68V	3.82V	4.00V	4.18V	4.36V	4.54V	4.72V	4.94V	5.17V	5.43V	5.80V	6.52V	> 6.52V
1+R/Red	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
2+R/Orange	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	1
3+R/Yellow	51	52	53	54	55	56	57	58	59	60	61	62	63	64	1	2
4+R/Lt Green	52	53	54	55	56	57	58	59	60	61	62	63	64	1	2	3
5+R/Green	53	54	55	56	57	58	59	60	61	62	63	64	1	2	3	4
6+R/Blue	54	55	56	57	58	59	60	61	62	63	64	1	2	3	4	5
7+R/Violet	55	56	57	58	59	60	61	62	63	64	1	2	3	4	5	6
8+R/White	56	57	58	59	60	61	62	63	64	1	2	3	4	5	6	7

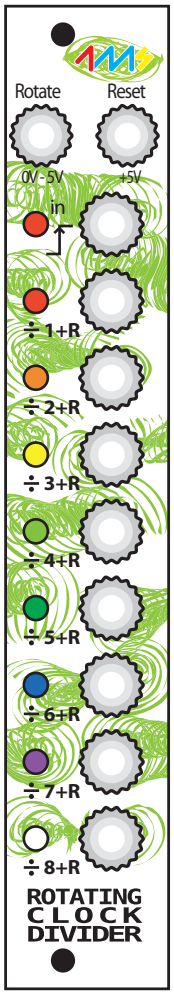
TRIGGER MODE, UP-BEAT COUNTING (NO JUMPERS IN 7&8)



GATE MODE, DOWN-BEAT COUNTING (BOTH JUMPERS 7&8)

↴ Indicates falling-edge of clock input (all others are rising-edge)



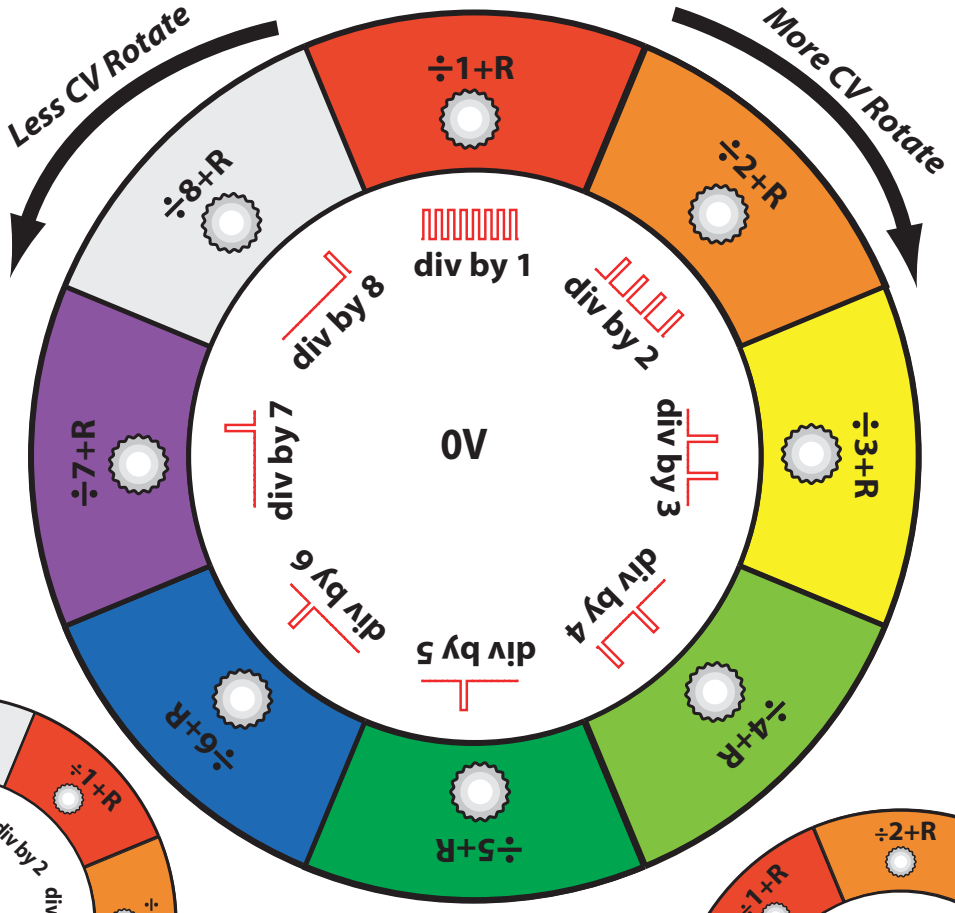


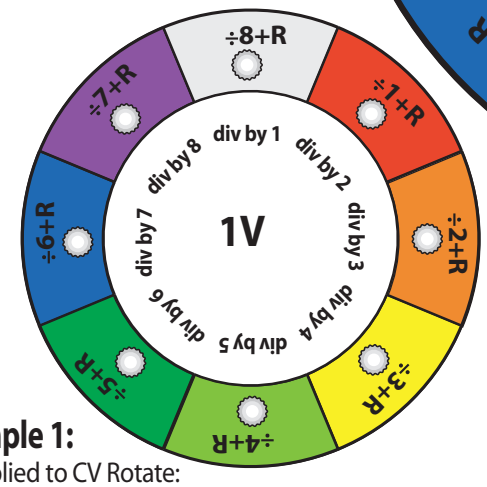
4ms Rotating Clock Divider

How CV Rotate Works

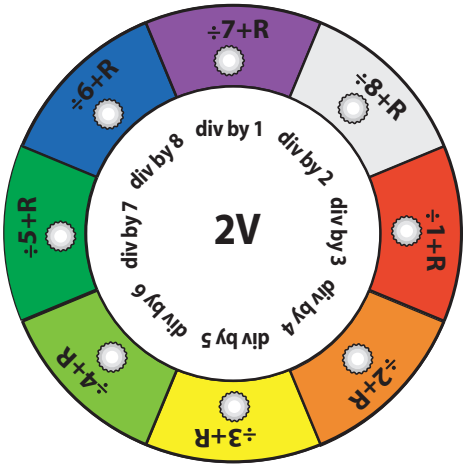
In this metaphorical illustration, applying a voltage to the Rotate jack makes the outer circle of jacks rotate around the inner circle of divided clock signals. For a technical chart of the exact voltages needed to cause exact rotations, see the User Manual.

This page assumes all jumpers are in their factory positions: i.e. only jumpers 3 and 4 are "in"

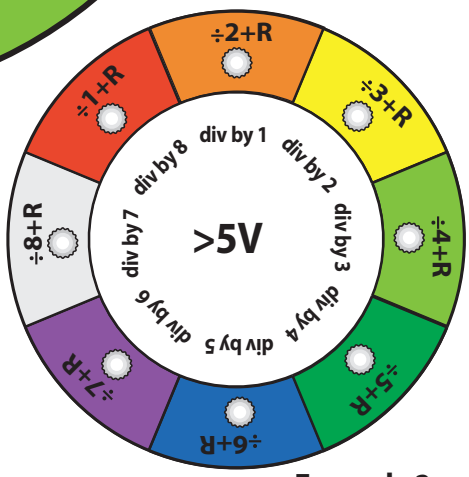




Example 1:
1V applied to CV Rotate:
(Jacks shifted 1 unit clockwise)
1+R: div by 2
2+R: div by 3
3+R: div by 4
4+R: div by 5
5+R: div by 6
6+R: div by 7
7+R: div by 8
8+R: div by 1



Example 2:
2V applied to CV Rotate:
(Jacks shifted 2 units clockwise)
1+R: div by 3
2+R: div by 4
...
7+R: div by 1
8+R: div by 6



Example 3:
5.1V applied to CV Rotate:
(Jacks shifted 7 units clockwise)
1+R: div by 8
2+R: div by 1
...
7+R: div by 6
8+R: div by 7