SERGE Divide by N Comparator (÷N COM) for Eurorack

The ÷N COM is a rare, much sought-after and very essential Serge module covering a number of functions: comparator, voltage-controlled pulse divider, and voltage-controlled staircase generator.

The ÷N COMPARATOR consists of two sections - a comparator (right side) and a voltage-controlled pulse divider (left side). The ÷N output of the pulse divider sends out a pulse on every N-th comparator pulse where N is a number from 1 to 31. N can be (pre-)set with the divider's control knob (1 ÷N) and can by changed with a control voltage. The VC knob (attenuator)on the bottom of the left side determines how much effect the control voltage has on "N". In addition, the divider generates a staircase waveform with N steps. This can be used to produce whole-tone steps when run into the 1V/Oct input of a VCO or as a stepped control voltage to change for instance the cutoff of a filter.

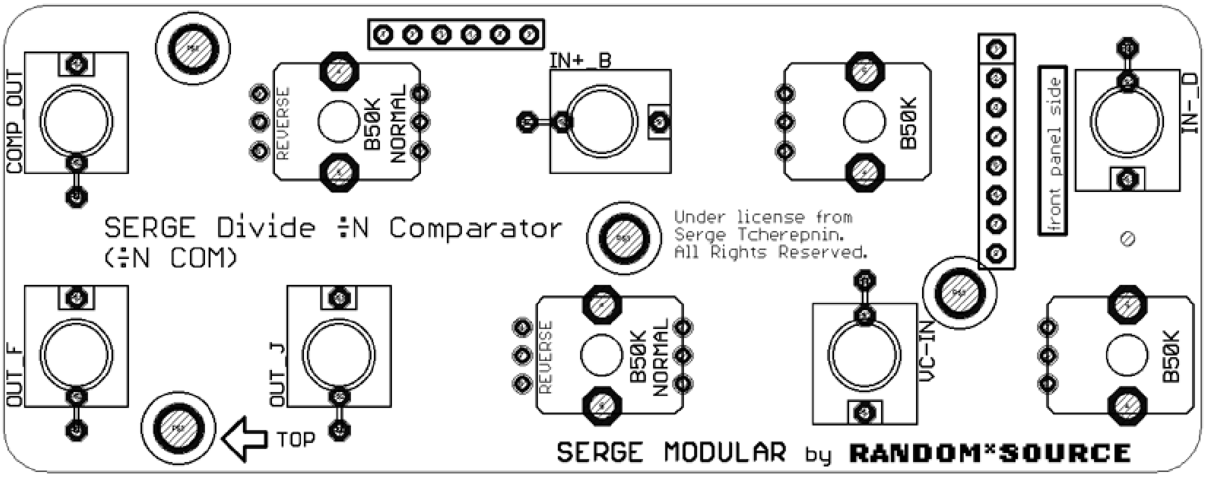
The comparator provides a number of useful "housekeeping functions": Logical decisions (if the +input is greater than the -input, the output will be high, otherwise low), Level detection (whenever a variable waveform crosses the theshold, a pulse is generated), Pulse width modulation or Rectifying a waveform (e.g. a sine or triangle wave). More uses are explained in the original 1983 Serge catalog:

For audio frequencies the divider can be set to output sub-divided frequencies with digital precision: Output frequency depends on "N". If "N"= 2, 3, 4, etc. the output frequencies will be an octave, an octave and a fifth, or two octaves below the input, respectively. Because ''N" is voltage controllable, arpeggios and various melodies can easily be programmed. The nature of this type of divislon (Integer division) results in frequencies that fall along the sub-harmonic series, a series that has great tonal charm.

For sub-audio frequencies. the divider acts like a counter. Outputting a pulse only after ''N" number of input pulses. Input pulses can be fairly random or reqular. This capability is especially powerful for detrmining tempos and rhythmic patterns when using several sequencers (especlally if the "N" VC input is taken from one of a sequencer's rows of controls). In a more random situation, using a microphone preamp / detector as input, the divider might be set to count how many times a sound of a certain lloudness will have occured and be set to trigger an event upon reaching the count. Since the count can be made variable (from 1 to 31), frairly complex and subtle interactions can be generated.

The Random*Source version of the ÷N COM for Euro is a licensed and authorized adaption of the original Serge design. Compared to the original module it features a precision voltage source for increased accuracy and 2 added attenuators.

The Random*Source ÷N COM kit consists of a front panel, a main pcb and a panel pcb serving as an interface to the front panel.



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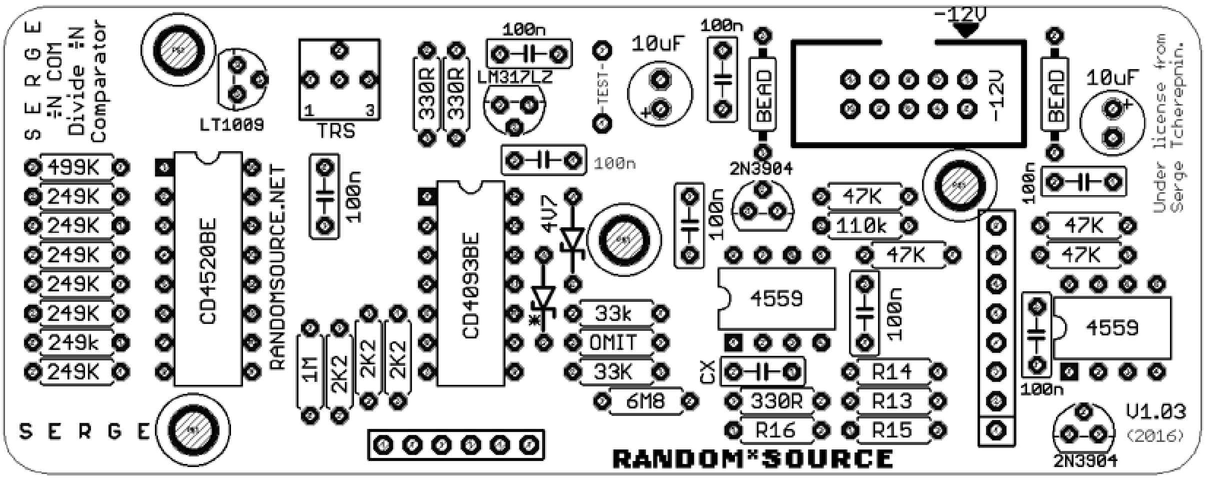

Please note:

- The pcb provides for a (new) precision voltage source that should be set up (using the trimmer) so that the CMOS parts are run on a (stabilized) exact **voltage (5.116V)** - as Serge explains: “One of the features of the NCOM is its adherence to the 1V octave rule, which permits directly plugging the staircase out into a VCO and getting a whole tone scale.”
- The component pcb contains footprints so that that pots can be inserted to work in either direction (“normal” and “reverse”), “normal” should give the expected pot behavior.
- Big thanks to Phisynth and Guy D.!
- Board is designed to be powered by a +/-12V stabilized PSU only. (+/-15V is untested).

Bill of Materials

The following values are suggestions and may deviate from other / older versions of the ÷N COM: - this is DIY!

Resistors (1%)

2	BEAD	F1, F2	Resettable Fuse (PPTC, Bourns MF-R005-0 - carefully bend legs to fit the footprint) or Ferrit Bead
2	OMIT	R18	* do not install *
3	330R	R25, R26, R31	
3	2k2	R1, R9, R28	
1	15k	R16	
2	33k	R11, R27	R27 is marked "10k" on the pcb - you can use 10k (instead of 33k) here, but should install the 4.7V zener diode (marked "4V7") right next to it.
4	47k	R4, R6, R7, R8	
2	51k1	R13, R15	
1	110k	R5	
1	121k	R14	
7	249k	R3, R10, R12, R21, R22, R23, R24	1% or better - ideally closely matched
1	499k	R20	1% or better
1	1M	R19	
1	6M8	R17	
1	100R	TS (Precision Voltage)	Trimpot (Bourns 3362P or anything that matches the footprint) to adjust the Voltage to 5.156V - or any value that yields the desired 1V/Oct scaling of the stepped output (tune sending the stepped output into the 1V/Oct input of an oscillator). Use a good DMM and measure between the two test pads ("- TEST -").

Capacitors

1	47p*	CX	Use larger value e.g. 1nF, I used 220p which seems to work nicely, too.
8	100n	C5, C6, C7, C8, C9, C11, CB1, CB2	Bypass caps
2	10uF	C1, C2	Electrolytic (or 22uF) >= 25V, 2.5mm ls

ICs

2	4559	U2, U5	NJM4559D or RC4559P
2	2N3904	Q1, Q2	NPN Transistor
1	CD4093BE	U1	Quad 2-input NAND schmitt trigger
1	CD4520BE		Dual binary up COUNTER
1	LM317LZ		Positive VOLTAGE REGULATOR
1	LT1009C	U7	Precision Shunt
2	ZENER 4.7V	D1, D2	Optional: Zener Diodes as CMOS input protection Install "4V7" if you use 10k for R27 - see above.

Misc

1	Euro Power header		MTA-100 power connector, Reichelt: WSL 10G
1	SIL header 8pol		pin connectors, linking main pcb to component
1	SIL header 6pol		pcb - using precision strips allows to break off pieces as needed
6	Thonkiconn Jacks		3.5mm Jack Sockets (PJ301M-12) from Thonk
5	Potentionmeter 50k	linear (B50K)	Alpha 9mm vertical pcb mount available from Thonk, Tayda, Mouser ... B100K should also work

Building

This is simply a suggestion - you might find a different workflow more practical:

1. **Use a side-cutter to separate main pcb and component pcb.**

2. **Mount the Thonkiconn jacks, the pots and the switch onto the component pcb. Pots should sit on the side facing the front panel (as marked on the board). Don‘t solder them in yet.**

3. **Carefully mount the component pcb (with the pots etc. inserted) onto the front panel. You may then have to wiggle each pot a bit to get the pots through. Make sure the threads of the pots go through completely and the pots sit right at the front panel. You can even screw the jacks and pots to the panel to make sure of that, but you will have to unscrew them again later.**

4. **Once everything is nicely in place, solder the pots, jacks und switch onto the component pcb (while the front panel is attached).**

5. **Stuff the main board, beginning with the resistors, then caps etc.**

6. **Main pcb and component pcb are to be connected through precision DIP socket and pins. It is recommended to use the pins on the main pcb (facing down, soldered from above) and the pin sockets on the component pcb (standing up, soldered from the front panel side). Break or cut off the pieces you need and stick them together so that main pcb and component pcb form a nice sandwich (don‘t solder yet). Check that you didn‘t leave out any pins / holes and that the sockets are all on the same side (component pcb). Solder all the pins in while keeping the sandwich together - this avoids any misalignments.**

7. **Carefully separate the sandwich - if you used precision sockets, this may not to too easy - they stick together nicely (giving a good connection).**

8. **Mount the component pcb onto the front panel again and screw on the pots from the front side.**

9. **Make sure everything is in place.**

10. **Attach any screws / spacers if desired and mount the main pcb onto the component pcb.**

11. Connect a power cord supplying +12V, GND, GND, -12V to the power-header on the main board and double check the direction of the power header before you turn power on. You should be ready to go :-)

Calibration

Using TS, the **voltage for the CMOS parts** can be adjusted to precisely to 5.155V. Use a good digital multimeter and measure the voltage between the 2 test pads (next to the 4520 IC, marked " - TEST -" and adjust the trimmer. You can also run the stepped output into the 1V/Oct input of a VCO and adjust the trimmer so that the pitch of the oscillator stepping up stays in tune.

(Version 20 April 2016)