# VC Clock Module

Here we have a (Master-)Clock Module providing voltage control over the speed and pulse width. The CV input for the speed has an attenuator, while the CV input for the PWM has an attenuverter. It utilizes a falling ramp VCO core and a comparator for creating the pulse. Since the comparator compares a threshold value to the falling ramp, the clock will keep in timing even when we modulate the pulse width. Just take a look at the graphic below:
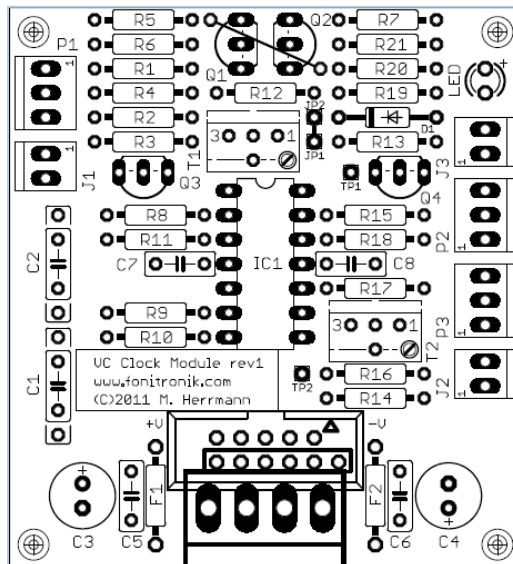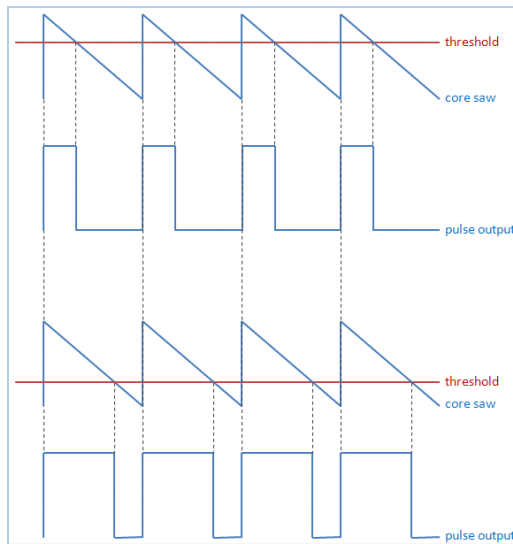
Semi's		
Qty	Value	Parts
3	2N3904	Q1, Q2, Q4
1	2N3906	Q3
1	TL074	IC1
1	LED	LED

Connectors			
Qty	Value	Parts	
1	Saw out	TP1	see calibration instructions
1	Att. out	TP2	
1	Speed CV	J1	
1	PWM	J2	see wiring instructions
1	Clock out	J3	
2	m/s	JP1, JP2	

Capacitors		
Qty	Value	Parts
1	100p	C1
1	10n	C2
4	100n	C5, C6, C7, C8
2	10uF	C3, C4

Resistors		
Qty	Value	Parts
2	1k	R5, R19
1	1k*	R20
1	2.2k	R11
1	2.2k**	R21
1	4.7k	R10
3	10k	R8, R9, R14
2	22R	F1, F2
2	47k	R1, R13
1	68k	R17
9	100k	R2, R3, R4, R6, R7, R12, R15, R16, R18
2	100k	T1, T2 (Precision Trimmer)
3	100k	P1, P2, P3 (Potentiometer)

* Optional: R19 and R20 form a voltage divider. The higher the value of R20, the higher the voltage of the pulse output.

** Value depends on the LED used. For common low current LEDs 2.2k will be fine. For super-bright you will have to increase this value.

Wiring Instructions/Options

There are several options how to wire this module, depending on your setup: Do you want to use it as a single unit, or as a multiple version with master/slave modes?

If you build it as a single version then you have to connect JP1 and JP2 (this will connect the VCO section with the comparator section). JP1 and JP2 can also be used for implementing a on/off switch for a single unit, and/or a mode switch for a multiple version (e.g. self/off/slave). More below.

In the 1st diagramm only the basic wiring for all the common front panel components is shown:
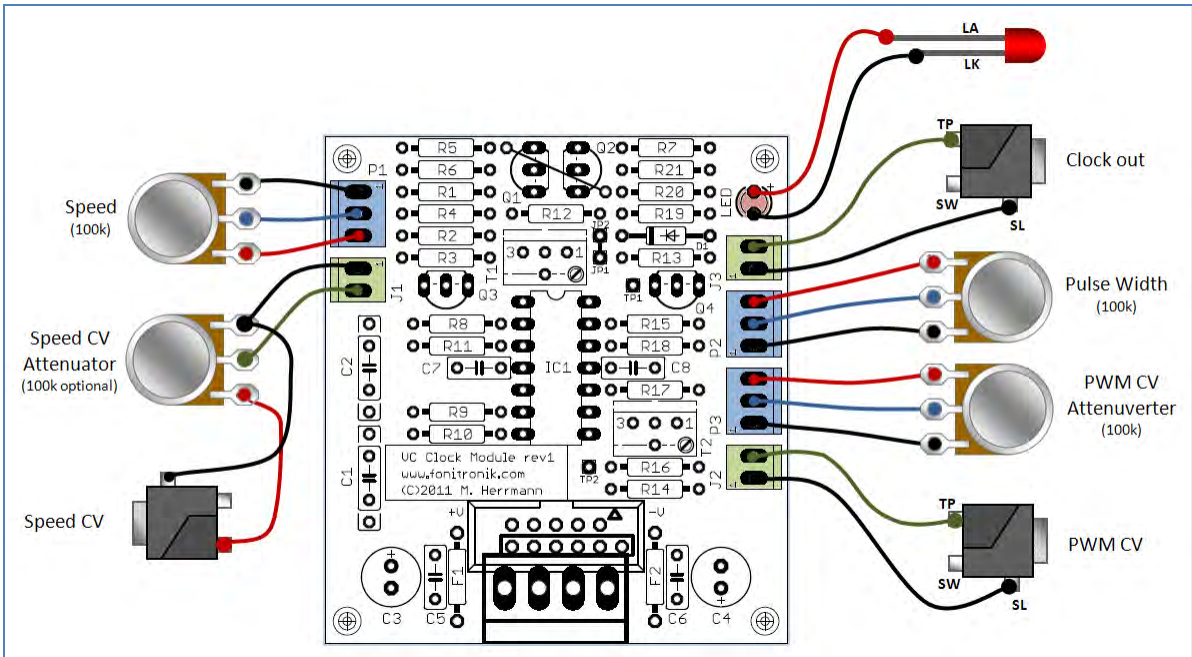
There are several options to connect multiple PCBs. Below you see an example how to wire 3 units, one master and two slaves:
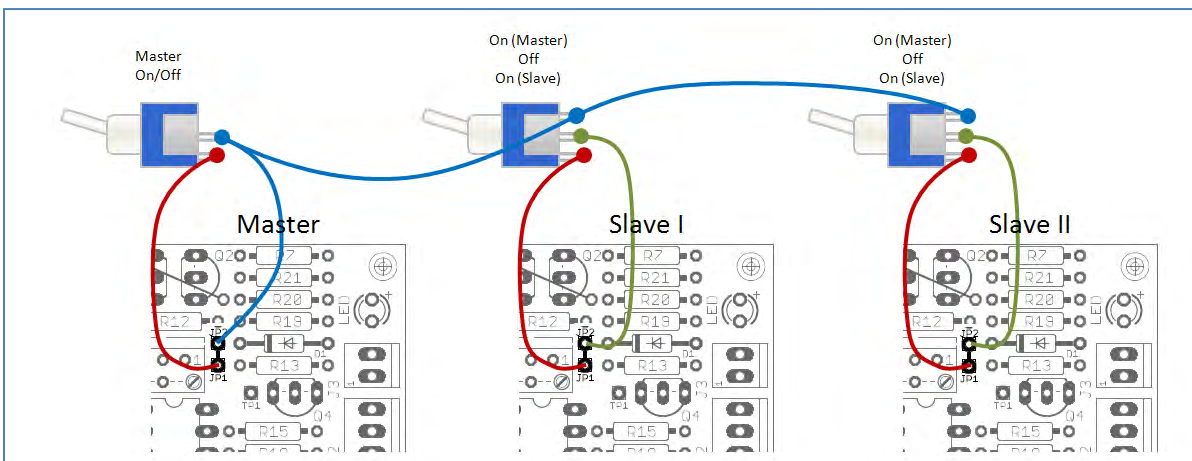
On the 1st module (master) the **red** wire connects the clock signal to the Master On/Off switch. From there the clock signal is routed to the master modules comparator section, and to the slave modules On/Off/On switches (**blue** wire). The On/Off/On switches of the salve modules connect either the master clock signal (**blue** wires) or the slave clock signal (**red** wires) to the comparators (**green** wires).

Calibration

Set the VCO core ramp amplitude to 5V:
The resistors in the comparator section are chosen for 15V operation, assuming an incoming ramp with an amplitude of 5V. TP1 carries the same signal as JP1 (the VCO out) for measurement purposes. Use trimmer T1 to set the amplitude.

Set the Zero position of the attenuverting potentiometer:
Apply any voltage to the PWM input (J2). Put the attenuverting potentiometer in 12 o'clock position. Turn trimmer T2 until you measure 0V at TP2 (Attenuverter out).

12V Operation

This module has been designed for 15V operation, however you can run it with almost any other dual supply.
For 12V operation you should change R13 to 20k and R14 to 15k to adjust the PW potentiometers response.
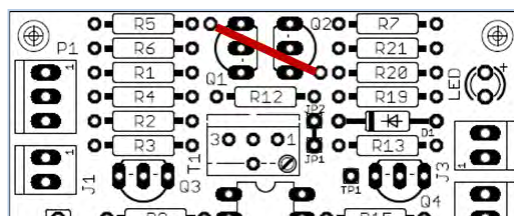
1V/Oct

For a 1V/oct response replace R1 by a 22K resistor. Instead of the attenuator as shown in the wiring diagram, use a 50k trimmer between the Speed CV input socket and J1, wired as variable resistor:
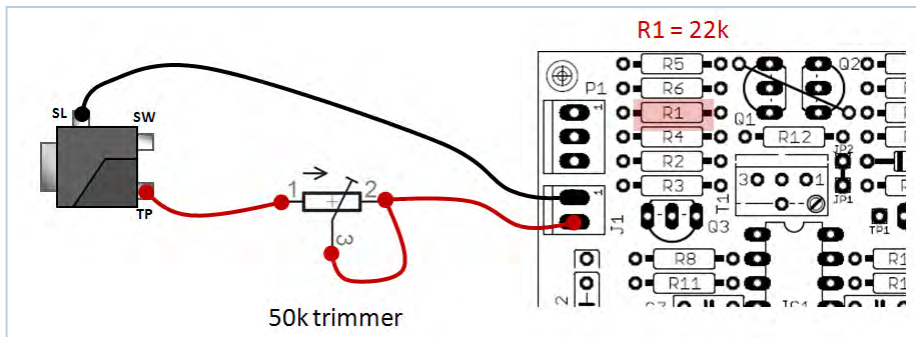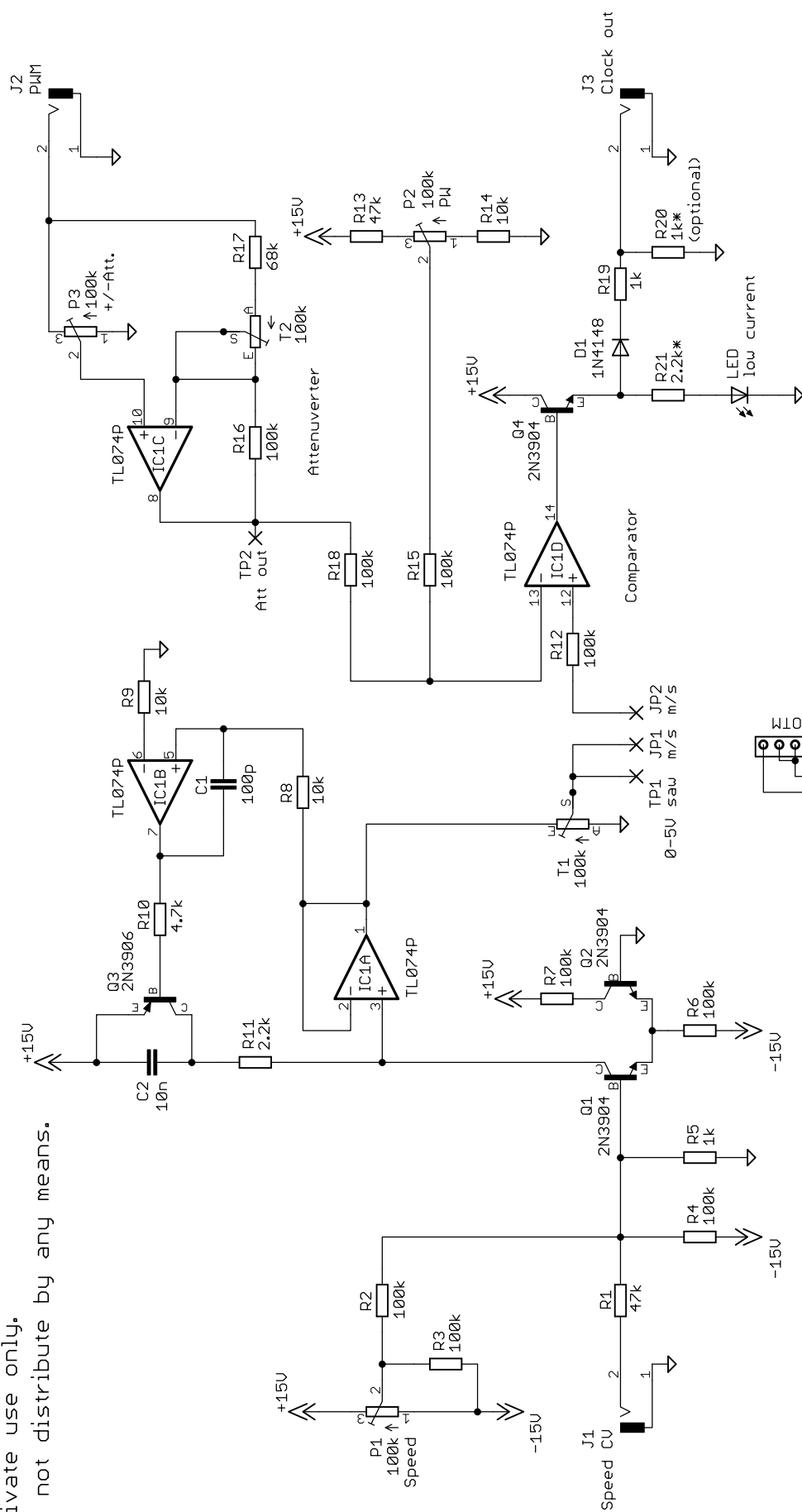

Tempco

You want temperature compensation? Use a tempco resistor for R5 and mount it in termal contact on top of the transitors Q1/Q2.

Private use only.
Do not distribute by any means.

Single IC Clock Module
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* Value depends on your needs.

J2 PWM

J3 Clock out

R13 47k
P2 100k PW
R14 10k
+15V

R20 1k* (optional)

R19 1k
D1 1N4148
R21 2.2k*
LED low current

+15V

Q4 2N3904

P3 100k +/-Att.
R17 68k
T2 100k
Attenuverter

TL074P IC1C

R16 100k

TP2 Att out

R18 100k
R15 100k

TL074P IC1D
Comparator
R12 100k

JP2 m/s
JP1 m/s
TP1
0-5V saw

R9 10k
TL074P IC1B
C1 100p
R8 10k

Q3 2N3906
R10 4.7k

T1 100k

IC1A TL074P

+15V
R7 100k
Q2 2N3904
R6 100k
-15V

Q1 2N3904

+15V
C2 10n
R11 2.2k

R5 1k

R4 100k
-15V

P1 100k Speed
R2 100k
R3 100k
+15V
-15V

R1 47k

J1 Speed CV

X1-10
X1-9
X1-8
X1-7
X1-6
X1-5
X1-4
X1-3
X1-2
X1-1

+15V
GND
-15V Doepfer/dotcom

MOTM

F1 22R/ferrite
C3 10uF
C5 100n
C7 100n
+15V

F2 22R/ferrite
C4 10uF
C6 100n
C8 100n
-15V