VS010 - 1080pPants

Bill of Materials V1.1
August 2020

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(links are to dutch distribution sites)

IC’s

U1	CD74HC4060	https://nl.farnell.com/texas-instruments/cd74hc4060e/logic-14-stage-bin-counter-16dip/dp/3119787	€0.48
14-stage high speed CMOS Binary Counter with oscillator			
U2	CD74HC4059	https://www.digikey.nl/product-detail/nl/texas-instruments/CD74HC4059M96/296-9221-1-ND/376772	€2.08
divide by n counter			
U3, U4 & U5	CD74HC4538	https://nl.farnell.com/texas-instruments/cd74hc4538e/logic-multivib-mono-dual-hs-16dip/dp/3120780	€0.60
Dual Retriggerable Precision Monostable Multivibrator			
U6	CD74HC4053	https://nl.farnell.com/texas-instruments/cd74hc4053e/ic-logic-74hc-decoder-demultiplexer/dp/3009601	€0.46
Digitally Controlled Analog Switch			
U7	L7805	https://nl.farnell.com/stmicroelectronics/l7805abv/ic-v-reg-5v/dp/1467758	€0.49
Digitally Controlled Analog Switch			
footprint for the small version			

diodes and crystal

X1	Quartz Crystal – 17.28 MHz	https://nl.farnell.com/txc/9b-17-280maaj-b/crystal-17-28mhz-18pf-11-5mm-x/dp/2819250	€0.28
D1 - D8	1N4149	https://nl.farnell.com/on-semiconductor/1n4149/small-signal-diode-0-5a-do35/dp/1651147	€0.08
D9	1N4001	https://nl.farnell.com/vishay/1n4001-e3-54/rectifier-single-1a-50v-do-204al/dp/2889052	€0.17
D10 - D11	1N4149		

resistors
1/4 watt 5% or 1%

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note: stated values R1 - R6 are specific to a 1080p60 standard. R7 & R8 may vary depending on the requirements of X1.

R1	1K2	https://nl.farnell.com/vishay/mrs25000c1201fct00/res-1k2-1-600mw-axial-thin-film/dp/9465251	€0.11
R2	16K		
R3	10K		
R4	10K		
R5	12K		
R6	10K		
R7	100K		
R8	2K2		
R9-R11	optional. depends on application.		
R12-R14	optional. also depends.		
R15 (aka BR1)	zero Ohms. This is just a bridge.		
R16, R17	68R		
R18, R19	1K		
R24	10K		
R25-R27	suggesting 100 Ohm.		

RN1 fixed resistor network, 6 elements, 7 pins, 47K
https://nl.farnell.com/bourns/4607x-101-473lf/res-n-w-bussed-47k-0-2w-sip/dp/2908109 €0.47

trim pots

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optional, but very handy for adapting to different VGA devices… for eg. trimming margins (blanking) on cheap VGA-to-HDMI converters
the PCB footprint is piher PT-6 series (V version) -
eg. https://nl.farnell.com/amphenol-piher-sensorscontrols/pt6wv-471a2020/trimmer-470r-0-1w-1turn/dp/3128595?st=trimmer

R1b, R2b, R3b, R4b, R5b, R6b	optional trim-potentiometers for more precision in tuning of R1-R6 values. a value of 10K could be the most versatile:	https://nl.farnell.com/amphenol-piher-sensorscontrols/pt6kv-103a2020-pm/trimmer-10k-0-1w-1turn/dp/3128573	€0.90
	but I have been using 470R and 1K for testing:		
470R		https://nl.farnell.com/amphenol-piher-sensorscontrols/pt6wv-471a2020/trimmer-470r-0-1w-1turn/dp/3128595	€1.18
or 1K (depending)		https://nl.farnell.com/amphenol-piher-sensorscontrols/pt6kv-102a2020/trimmer-1k-0-1w-1turn/dp/3128572	€0.80

Capacitors

notes:
- stated values C1 – C6 are specific to a 1080p60 standard. C7 & C8 may vary depending on the requirements of X1.
- C1 – C8 and C19 – C24 are run of the mill Radial Leaded Multilayer Ceramic Capacitors
  - having a kit with a range of standard values is recommended
    - eg. https://www.velleman.eu/products/view?id=354878
    - or https://nl.farnell.com/vishay/hotc-kit-kh/capacitor-sample-kit-aec-q200/dp/2544879
- C9 – C18 standard electrolytics
  - again, having a standard selection recommended
    - eg. https://www.velleman.eu/products/view/?id=354882

C1	0.1nF	
C2	10nF	
C3	10nF	
C4	220pF	
C5	0.1nF	
C6	100nF	
C7	10pF	
C8	22pF	
C9, C10, C11	optional polarized AC coupling input capacitors. 47uF should be fine.	
C12, C13, C14	optional polarized AC coupling output capacitors. Try different values, but go big, 330uF-10volts should be a good start.	
C15, C16	if you can fit some 100uF-50volt electrolytic caps in there, do that. I used 47uF for one, and 100uF for another.	
C17	there isn't one	
C18	10uF electrolytic makes sense	
C19 – C24	0.1uF aka 104 aka ceramic disc powersupply bypass capacitor. One for each IC. https://nl.farnell.com/kemet/c320c104k5r5ta/cap-0-1-f-50v-10-x7r/dp/1457655	€0.43

Switch

SW1
DIP switch
https://nl.farnell.com/omron/a6t6102/switch-dip-6-way-sealed/dp/1960930 or €1.87
https://nl.farnell.com/apem/ndir06st/switch-dil-6way/dp/1082468 or
https://nl.farnell.com/omron/a6e-6104-n/dip-switch-6pos-spst-raised/dp/2749948, etc. €2.88

Jacks

J1–J5 MJ-3536 - right angle thonkiconn jacks (aka PJ302M) https://www.thonk.co.uk/shop/3-5mm-jacks/

J6 Dsub-15 (VGA) right-angle PCB conn https://www.digikey.com/product-detail/en/norcomp-inc/181-015-213R561/181-215RFE-ND/1767725
- I used this, doesn't actually fit great, but it fits. A bit fiddly to get in there though.
- KiCad footprint I used was generic "DB15_Female_HighDensity_MountingHoles"

J7 eurorack 10pin power connector: https://nl.farnell.com/harting/09-19-510-7324/header-straight-10way/dp/1106784

J8 this can be any generic power connector; screw terminal for example

J9–J10

sockets and headers

some components are placed on the PCB so that DIP sockets can be used to easily swap different values. sockets should really be the ones with round, small holes, so they hold standard resistors and capacitors well. hot glue if nervous about things vibrating loose in the long run.

6pin DIP sockets:
C12 - C13
R9 - R11
R12 - R14
R25 - R27
https://nl.farnell.com/multicomp/spc15560/dip-socket-6pos-2-54mm-th/dp/2678581

8pin DIP socket
R1a–R4a, C1–C6
https://nl.farnell.com/preci-dip/110-87-308-41-001101/dip-socket-8pos-2-54mm-th/dp/2839831?st=dip%20socket or
https://nl.farnell.com/aries/08-3518-10/socket-dip-8way/dp/1674784?st=dip%20socket or
https://nl.farnell.com/amp-te-connectivity/808-ag11d-esl-lf/socket-ic-dil-8way/dp/1077344?st=dip%20socket

10pin DIP socket
C8a, R8, R7, C7, X1
https://www.digikey.nl/product-detail/en/on-shore-technology-inc/SA103000/ED3069-5-ND/3935340 or
https://www.digikey.nl/product-detail/en/mill-max-manufacturing-corp/299-43-310-11-001000/ED90159-ND/1212056
such sockets seem difficult to obtain. just use two 6pin sockets, but remove 2 pins from one of them (usually easy to push out)

pin headers for jumpers
8pin 2 row
W1–W3
https://nl.farnell.com/samtec/tsw-104-07-g-d/connector-header-8pos-2row-2-54mm/dp/2856692
4pin 2 row
W4–W6
https://nl.farnell.com/samtec/tsw-102-07-g-d/connector-header-4pos-2row-2-54mm/dp/2856669
jumpers
https://nl.farnell.com/harwin/m7581-46/open-shunt-socket-2pos-2-54mm/dp/3226076

IC substitutions

- for U2 I have been using CD4059 – the lower frequency response is no problem for our purposes.
- One might consider substituting HCT for HC parts.
- for U6, I have also been using CD74HCT4053. No issues, datasheet mentions marginally slower on/off times.
- HC4538 can't really be substituted with something like an HEF4538. Not for 1080p at least. Reasons.
- U7 could be a L78L05 – small package version of L7805 voltage regulator.
  - https://nl.farnell.com/stmicroelectronics/l78l05abz/ic-reg-ldo-5v-100ma-to-92/dp/1564312
  - this is limited to 100mA. Driving one VGA load through output capacitors is fine with this, but just use the big 7805 for experimenting.

Other substitutions

- in the case of RN7, provisions have been made (extra holes) on PCB to allow the use of 6 standard 47K resistors, installed vertically, instead of a resistor network.
  - on U2, pins 8, 9, 10 & 16, 17, 18 can be selected as + (5volts) or – (GND) to program the jam inputs and select the chip's divide by number.
    - the schematic and PCB have marking to indicate which pins are positive for selection 1080p60/30 standard.
  - the 6 way DIP switch (SPST) needs these resistors for proper selection of + or – with an SPST switch.
  - a DIP socket with jumper wires could be used instead of a switch, RN7 or discrete resistors would still be needed.
  - the + and – connections can be hardwired to +5 or GND using the extra holes on the PCB if only one standard is needed.
- for normal use you'll need to choose J7 or J8, not both, obviously.

other

for mounting a BNC output shield under main-board -> RGB+Csync output for example
https://nl.farnell.com/molex/73101-0120/rf-coax-conn-bnc-jack-75-ohm-panel/dp/2612649
16mm standoff (M3 threaded sockets)
https://nl.farnell.com/harwin/r30-1001602/spacer-f-f-16mm-pk25/dp/517574
https://nl.farnell.com/wurth-elektronik/970160321/standoff-hex-female-female-16mm/dp/2884549
https://nl.farnell.com/ettinger/05-03-161/spacer-m3x16-vzk/dp/1466842

J9, J10

2 Pin-header / sockets (1 row, 6 contacts, 2.54mm spacing) –– (result should be 16mm (pin + socket)
https://nl.farnell.com/w/c/connectors/pcb-receptacles?pitch-spacing=2.54mm&no-of-rows=1rows&no-of-contacts=6contacts&connector-mounting=through-hole-mount
normal samtec pinheader - 1 row 6 contacts
https://nl.farnell.com/samtec/tsw-106-07-g-s/connector-hdr-6pos-1row-2-54mm/dp/2856716
for stacking pcb's as in multi monitor projects, and so on:
https://nl.farnell.com/samtec/esq-106-14-t-s/connector-6pos-rcpt-2-54mm-tht/dp/2984519