C19 DATABUS DRIVE
GUITAR SYNTHESIZER

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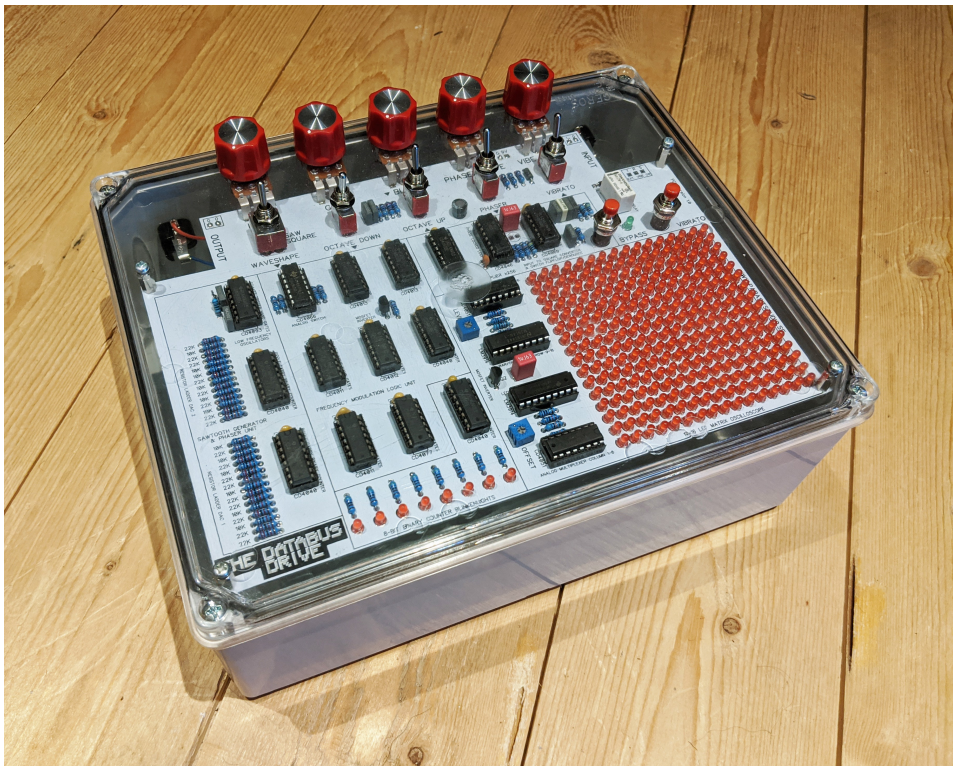
The C19 Databus Drive is a CMOS 4000-series based monophonic guitar synthesizer with a 16x16 LED matrix oscilloscope. It has two signal paths for unison/octave up and octave down (one or two octaves down). Each signal path has one type of modulation, vibrato (frequency modulation) and phaser. C19 stands for ”CMOS 19” (the number of chips on the PCB).

The PCB is designed for a custom made DIY enclosure with a transparent lid to display all the circuitry goodness and the LED matrix and counter.

This project is not recommended for the beginner or the casual effect builder. You should have some experience of successfully building DIY gear, good soldering skills and some troubleshooting knowledge before you attempt this project.

Also be aware that you also need to build your own enclosure with a transparent top cover. The PCB is not designed for any standard size enclosure (see page 7 ”enclosure notes” for more information).

Happy building and playing!



The first prototype build

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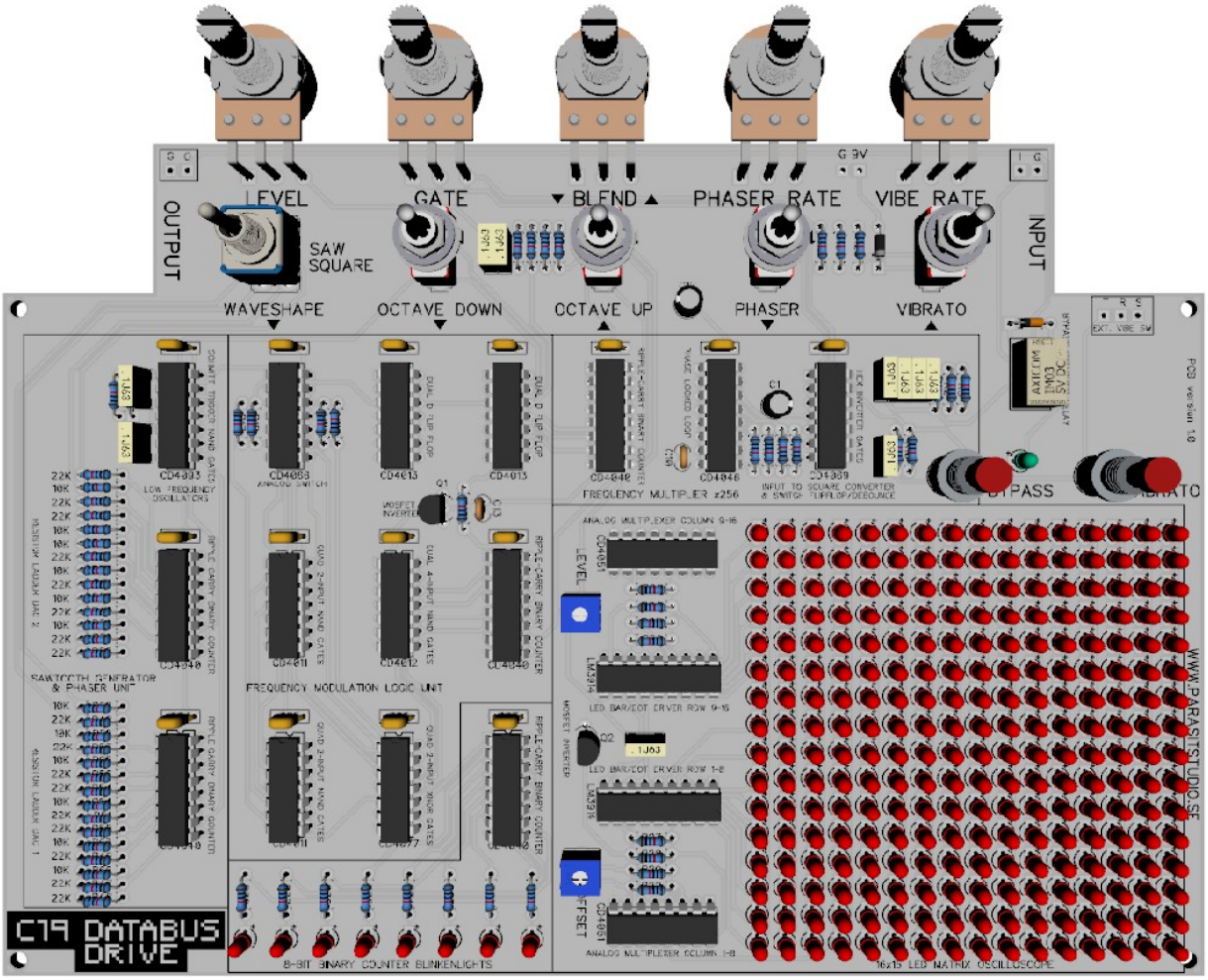
PCB 3D render

Here's a 3D render approximation of what the fully populated board should look like, except that the IC should have sockets and the electrolytics should be laying down. Unlike most guitar effect PCB's for through hole components, this one has all the components mounted on the top side (even the pots and switches) so that all components can be seen through the transparent top cover (that's the idea anyway).



General building tips

- First of all, choose if you want to start or end with soldering the 265 LED's. Those can be easier to solder first without any other components getting in the way. But if you do everything else first, then you can test that the signal/audio is ok before doing all those LED's. Soldering them are by far the most time demanding step of the build process, so it can be nice knowing everything else is working before starting with the LED's.

  When soldering the LED's, I recommend doing one row at the time. Just bend the legs out alittle to prevent them from falling off the board when turning it around. Make sure they are oriented correctly. The longer leg of the LED (which is the anode) goes in the square hole marked with a ”+”.

- Then just follow the Bill of Materials and solder the low profile components first.

  Recommended order: resistors and diodes, chip sockets, trim pots, multilayer and ceramic capacitors, film box capacitors, transistors, electrolytic capacitors, the relay, pots and switches, offboard wiring (jacks). Again, bend the legs of the components alittle bit to prevent them from falling out, or use tape to hold them in place while soldering.

- Pay special attention to the orientation of the LED's, diodes, transistors and electrolytic capacitors.

- The two electrolytics needs to lay down flush against the PCB to reduce height.

- Always use sockets for IC chips to avoid heating them directly. It also makes it much easier to swap them out if needed. With all 19 chips in this effect there's a chance that a chip or two may be faulty if you are unlucky. Don't insert the chip until you are finished with soldering all the components and the offboard wiring. The two transistors does not need to be socketed.

- CMOS chips are very sensitive to static charges and can be easily damaged. It's a good idea to wear a anti-static wristband. Or at least don't wear a woolen jumper and pat your dog while building, and keep the circuit away from rugs...

- Break off the small tap on the potentiometers, so they can sit flush against the top cover.

- When it's time to solder the potentiometers, switches and buttons I recommend having the enclosure/lid prepared to make sure that they line up with the holes.

  If you don't have an enclosure ready, print the drill template and make holes in a piece of cardboard to act as a placeholder. I usually start by placing the switches and buttons in the enclosure first and screw them in place without soldering them. Then I place the potentiometers on the PCB, and I solder only the middle pin of each potentiometer from the top side of the PCB so they don't fall out when turning the PCB around (but still leave some wiggle room). Then I mount the PCB to the enclosure (lid in this case) and make sure that everything lines up nicely before I solder the switches and buttons and the rest of the potentiometer legs into place.

C19 Databus Drive BOM (Bill of Materials)

Capacitors	**Value**	**Quantity**
C1	1uF	1
C2, C3, C6, C8, C9 C11, C14	100nF	7
C4	2.2nF	1
C5	4.7nF	1
C7	1nF	1
C10	100pF	1
C12	22uF	1
C13	470pF	1
C15-C29 (multilayer ceramic)	100nF	15
Resistors		
R1, R2, R3, R4, R9	1M	5
R5, R6, R15, R24, R28, R31-R38, R56-R67	10K	25
R7, R16, R17, R18, R19, R23, R30	100K	7
R8, R11, R39-R55	22K	19
R10, R21, R22	4.7K	3
R12, R13, R14	47K	3
R20	100R	1
R25	1.2K	1
R26	2.2K	1
R27	1K	1
R29	470K	1
Diodes		
D1, D2	1N4148	2
D3	1N4001	1
Light Emitting Diodes (LED's)		
LED Matrix oscilloscope	3mm diffused	256
Binary counter – 3mm LED's	3mm	8
Bypass Indicator LED	3mm	1

The BOM continues on the next page...

You can find a detailed **shopping list PDF** for Tayda Electronics at:
www.parasitstudio.se/C19databusdrive

If you have any questions about which type of components you need, check that list.

BOM Notes

- R21 and R22 sets the brightness of the LED matrix. They should be the same value at a minimum of 4.7K to not exceed current draw of the LM3914 chips, but if you are using a different colour (like blue) for the matrix, then you might want to increase the value of these resistors to something like 10K-22K to keep it from getting too bright.

- Note that knobs (5x) are not included in the BOM.

IC's	Value	Quantity
U1, U4, U11, U12, U15	CD4040 (BE)	5
U2	CD4069 (UBE)	1
U3	CD4046 (BE)	1
U5, U6	CD4013 (BE)	2
U7, U8	CD4011 (BE)	2
U9	CD4077 (BE)	1
U10	CD4012 (BE)	1
U13	CD4093 (BE)	1
U14	CD4066 (BE)	1
U16, U17	CD4051 (BE)	2
U18, U19	LM3914	2
Transistors		
Q1, Q2	2N7000	2
Potentiometers		
BLEND	B50K	1
LEVEL	B100K	1
PHASE RATE	C250K	1
VIBE RATE	C500K	1
GATE	B250K	1
Level trimmer	100K	1
Offset trimmer	10K	1
Toggle switches & push buttons		
Phase. Vibe, OCTup, OCTdown	SPDT on/on	4
Square/Saw	DPDT on/on	1
Bypass, Vibe (momentary push buttons)	SPST (NO)	2
Relay		
Mini relay DPDT	NA-12W-K	1
Sockets		
sockets for all 14-pin chips	14-pin DIP socket	9
sockets for all 16-pin chips	16-pin DIP socket	8
sockets for all 18-pin chips	18-pin DIP socket	2
Jacks		
Input and output jacks	6.3mm 1/4" mono	2
DC jack		1
PCB mounting hardware		
Standoffs	10mm	4
Screws	M3, 18mm	4
Nuts	M3	4

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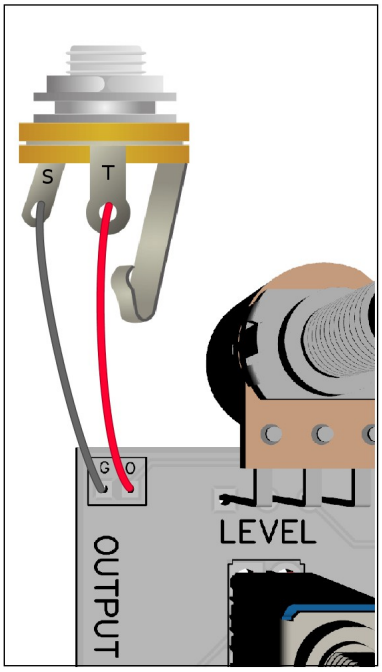
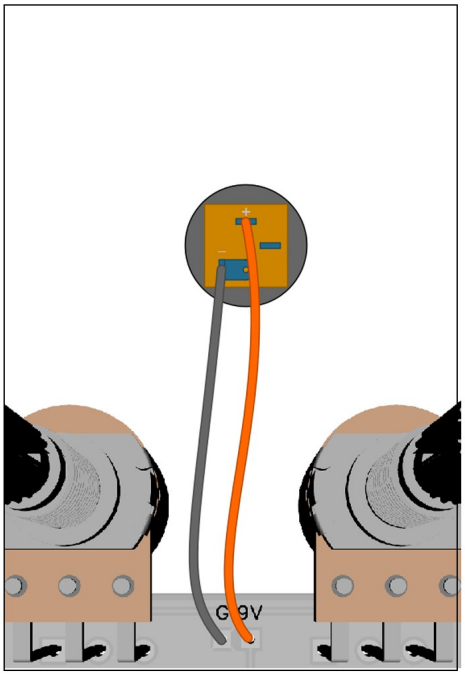
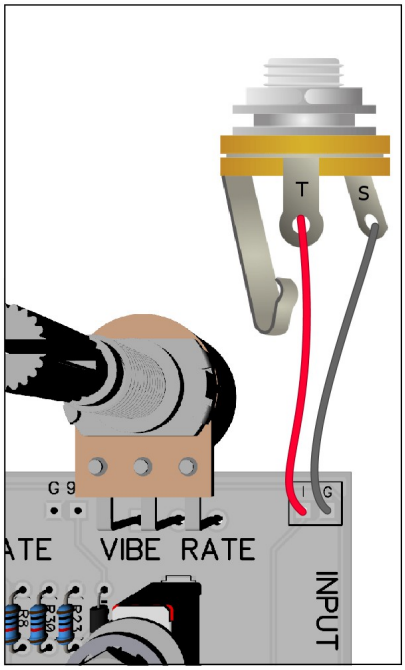
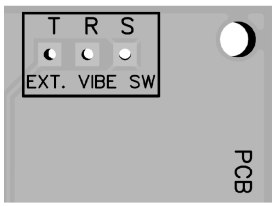
Offboard wiring diagrams







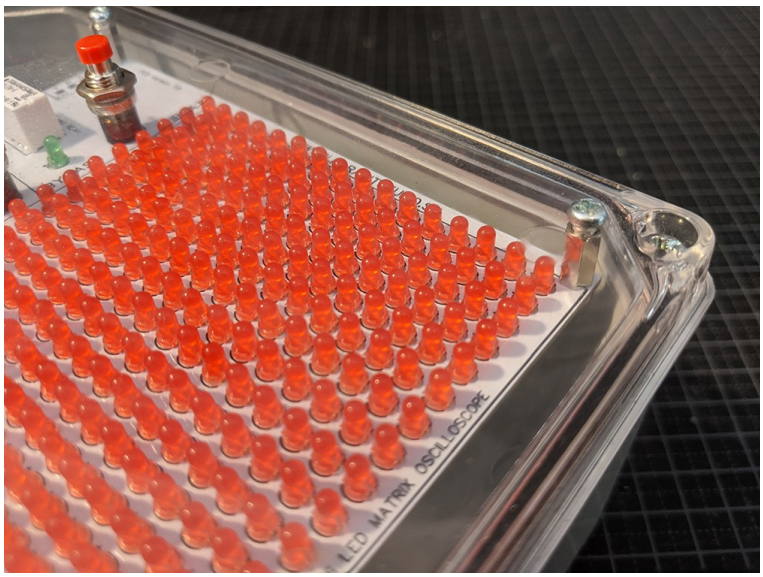
- Input jack tip – **I** (Input)
- Input jack sleeve – **G** (Ground)
- Output jack tip – **O** (Output)
- Output jack – **G** (Ground)
- DC jack positive lug – **9V**
- DC jack negative lug – **G** (Ground)



There's also extra connections avaliable for the vibrato button, in case you want to add an external footswitch to allow easier stomping. The idea is to connect this to a TRS jack and run a cable to another small enclosure (like a 1590A or 1590LB) with a TRS jack connected to a momentary footswitch. If you want to do this mod, then just connect the PCB holes to a TRS jack as marked, and on the other small enclosure you connect the tip and ring to the two lugs of a momentary SPST footswitch and leave the sleeve unconnected.

Board mounting

The PCB has four mounting holes in the corners for M3 screws. Use 10mm standoffs on the top of the PCB to attach it to the top cover, with the nut on the bottom side of the PCB. The screws needs to be around 18mm long (or longer) to reach through the top cover, standoff and PCB. Together with the pots and switch, it will hold the PCB firmly in place inside the enclosure.



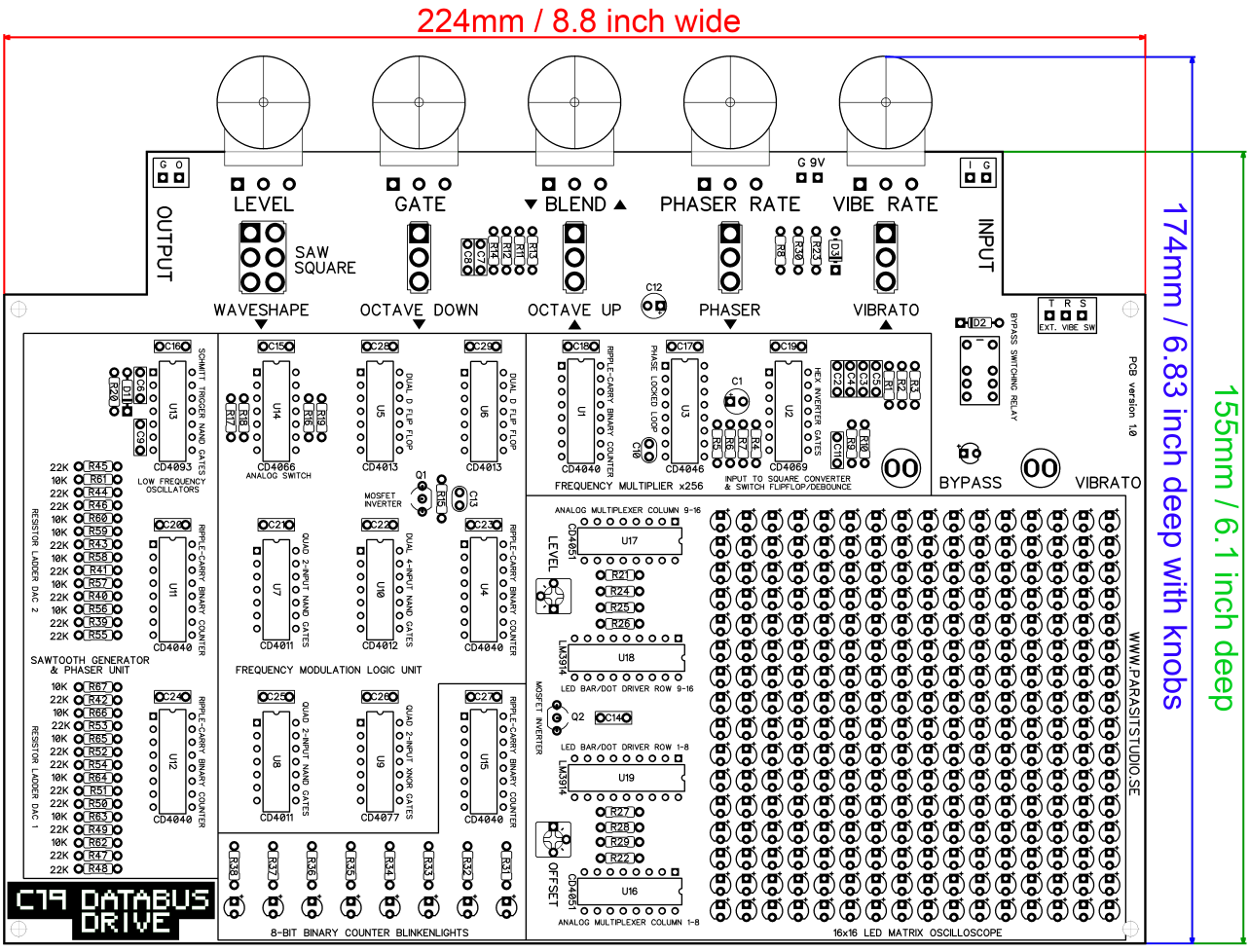
Enclosure notes

The C19 Databus Drive is not designed for any standard size enclosure, so go creative here with woodworking, sheet metal, acrylic, 3D printing, glue and transparent plastic, or find an old big cookie box ect...

If you really don't want to make your own enclosure, this is what I used for my first prototype: WISKA LTD, CLWIB 12 - Junction Box /w Clear Lid 190x240x90mm
It has the minimum required width and depth, but it's much taller than necessary.

PCB/Enclosure Measurements

These are the measurements for the minimum space needed inside the enclosure.
For locations of the knobs and switches, you can find a **drilling template PDF** at:
http://www.parasitstudio.se/C19databusdrive



Make sure to leave some extra room / wiggle space. If you are buying a premade enclosure, it may have rounded corners inside the enclosures. If so, make sure that it's bigger, like the 190x240 mm enclosure that I used for the prototype.

Usage/Controls

The C19 Databus Drive is pretty simple to maneuver. It has two signal paths, and the small arrow/triangles around the blend and underneath the switches tells you which signal path they correspond to, either the unison/octave up ▲ or the octave down ▼

This effect works best using a humbucker equipped guitar and using the neck pickup. It will give the best tracking and sustain. You can also try a boost pedal or a compressor in front to increase the sustain if your guitar has a weak output. Remember that it's monophonic, so play single notes and try to keep it clean to get the best sounds out of this effect.

Potentiometers

Level – Controls the overall output volume.

Gate – Controls how noisy and touch sensitive the pedal is, from making noise on it's own to gated and quiet. In some settings, specially with all the modulation active at high rates, you might have to turn the gate up fully to get it to be quiet when you are not playing. Just be aware that the sustain gets shorter when it's gating harder, and the tracking on higher notes also gets worse, so find that sweetspot.

Blend – Blends between the two signalpaths. Fully counter-clockwise you have the octave down signal, and fully clockwise you have the unison/octave up signal.

Phaser Rate – Controls the rate of the phaser (which affects the octave down only). Note that the phaser has it's quirks: the rate will also depend alittle bit on the note you are playing.
If the phase rate is turned to max it will sound very out of tune, so I recommend slow phaser rates for the best sounds.

Vibe Rate – Controls the rate of the vibrato.

Switches

Waveshape – Toggles between sawtooth and square wave (for the octave down).

Octave Down – Toggles between one or two octaves down.

Octave Up – Toggles between unison or octave up.

Phaser – Turns the phaser modulation on or off (for the octave down).

Vibrato – Turns the vibrato on or off (for the octave up).

The vibrato button *and vibrato switch does the same thing, but the button momentarily activates the vibrato when pressing the button, while the switch turns the vibrato on or off without having to press a button.*

I just like the idea to have a momentary control for the vibrato so I added both options, aswell as the optional offboard wired footcontrol.

Bypass button – Turns the pedal on/off. This is true bypass handled by the relay.

When first power on the effect, you might have to press the bypass button a couple of times before it starts to work correctly.

LED Matrix and Power Supply details

LED Matrix oscilloscope trimpots

Remember to set these up before installing the PCB into the enclosure. These are ”set-and-forget” trimmers, so there's no need to adjust them once they are set up.

Level – Adjusts the amplitude of the scope (what you normally call ”volts per division” on a normal oscilloscope). This control can be maxed, or slightly under max.

Offset – Moves the waveshape up and down on the scope.

I recommend that you set up the pedal to play only a one octave down squarewave.

- blend fully counter-clockwise
- waveshape switch in the down position.

Then adjust the offset trimmer until you have a clean looking squarewave that is centered (or slightly below center) on the LED matrix scope.

Oscilloscope sync explanation

The LED matrix oscilloscope is synched from the octave down signal path.

If you play only the octave down signal (blend fully clounter-clockwise), it will always display a single cycle waveshape (1hz per 16-steps) even if you are at one or two octaves down.

The unison/octave up signal is shown in relation to the octave down signal.
So for example, if the settings are:

- Octave down switch: one octave down
- Octave up switch: unison
- Blend: fully clockwise (so you only hear/see the unison signal

Then it will display a 2hz waveshape since the signals are one octave apart. If you toggle the octave down switch to two octaves down, the unison waveshape will now display at 4hz since they are now two octaves apart.

Binary Counter ”blinkenlights”

The 8-bit binary counter at the bottoms of the PCB is clocked from the vibrato LFO. It's just there for the looks and has no function in the circuit. I figured that the effect didn't have enough LED's already (hehe) and who doesn't love blinking lights?.. :0)

Power supply and current Draw

The C19 Databus Drive is designed to be used with a 9V DC power supply with a negative center (standard for most modern guitar effects).

The current draw is around 44mA
(I measured 39-41 average with peaks up to 44mA on my prototype).

Your power supply needs to be able to supply at least 44mA or more, but it's good to have a bit of safe marginal, so I recommend using a 50mA supply minimum. Also note that the current draw can vary alittle depending on which type of LED's and LED color you are using for the LED matrix.

Troubleshooting

There's always a chance of running into trouble. To minimize error, follow the BOM and general building tips carefully. Take your time and don't rush. Take a break now and then. Use good solder, and it helps to have a decent soldering station insted of a cheap iron.

Musikding DIY kit

If you have bought the Musikding DIY kit and have recieved a faulty faulty, incorrect or missing component, please contact musikding.

Contact us

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