GOD CITY INSTRUMENTS – MURDOCK V1.1 Build guide

The God City Instruments (GCI) Murdock is a tone shaping pedal derived from the EQ section of a Boss HM-2. The original HM-2 pedal has several gain and clipping stages followed by an EQ section. Despite having only two EQ controls, it is actually a 3 band gyrator EQ with the high and mid bands voiced fairly close together and controlled by a single pot. It is arguably this EQ, more than the gain stages, that create the classic HM-2 sound. Murdock allows the user to impart an HM-2 flavor to any other effects pedal by offering an EQ only version of that circuit. This PCB can be built as a stand-alone pedal or installed, space permitting, in existing pedals to modify them for HM-2 EQ. Try it with a GCI Brutalist Jr.!

This PCB circuit has the original HM-2 "color mix" controls fixed at maximum, however, the amount of EQ can still be controlled by a single pot labeled "EQ" which controls the boost of all 3 gyrators. When the pot is full CCW, the signal is not EQ'ed, when the pot is full CW, the signal is fully EQ'ed. Adjust the pot for the desired amount of HM-2 EQ tone. For traditional HM-2 signal flow, insert the EQ after all gain and clipping stages.

With this type of EQ topology, each band of EQ's frequency and bandwidth can not be adjusted independently from each other. However, if more tonal adjustability is desired, R7, R8, and R15 can be replaced by 500 ohm pots and R9, R10, and R16 can be replaced by 100k pots inline with 47k resistors. By adjusting these pots in pairs, the desired frequency response and bandwidth can be achieved.

Headroom is extremely important the achieve the full depth of EQ possible with this circuit. A loud distortion or boost pedal preceding Murdock can cause op amp clipping, reducing the apparent effectiveness of the EQ. TLE2074 is a rail to rail op amp with more headroom than a TL074, but it's also quite expensive. Alternately, more headroom can be achieved by changing the voltage divider formed by R5 and R6. Think of these two resistors as a single pot, with the output of the pot being the node between them If reducing gain at this stage causes the pedal to be quiet, the gain can be made up by adjusting R4 and R14 which set the gain of the op amp boost at the output. Be wary that increasing headroom can also increase noise floor.

This pedal is an easy build, but this guide is intended for people who have some experience building pedals. Component sourcing, component identification, assembly techniques, wiring stomp switches, etc. is not covered. The GCI Brutalist Jr. assembly guide has helpful information for less experienced builders. That guide can be found here:
http://www.kurtballou.com/brutalistjr/

For your convenience, complete parts kits including everything you need except the PCB can be purchased through Small Bear Electronics. Be wary that they may need to make substitutions for work-alike components which may or may not influence the tone of the pedal. Be aware that transistors may have been substituted for work-alikes with different pinouts.
http://smallbear-electronics.mybigcommerce.com/kit-murdock-pcb-not-included/

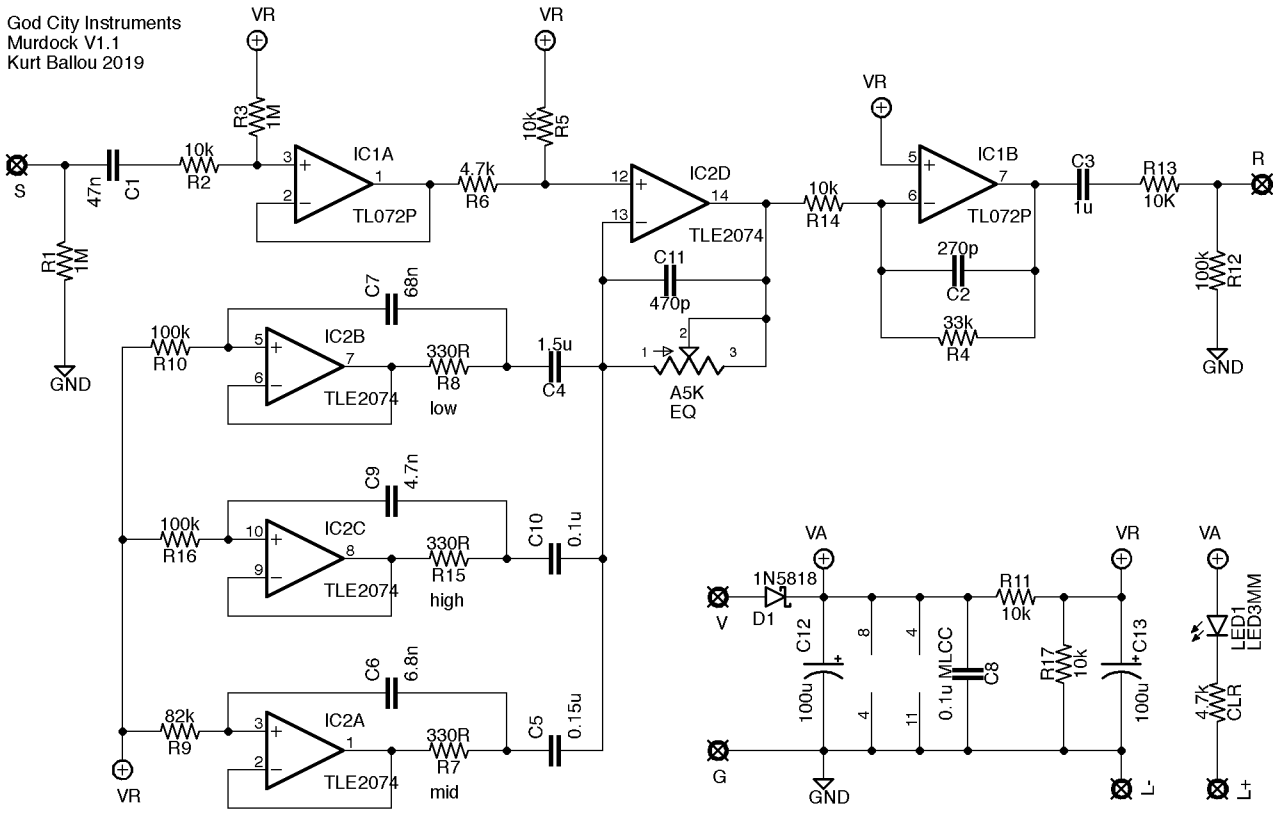
Available separately is the GCI 3PDT utility PCB for PCB pin 3PDT footswitches. This PCB makes footswitch wiring quick and easy. Not compatible with solder lug style switches.

Don't forget to connect the ground pad of the PCB to the ground lug of the input, output, and DC power jacks!

Due to the scope of this project, technical support is not available. However, consider joining the GCI DIY PCB Builders group on Facebook to get advice from and share your work with other builders. We require that all group members agree to the rules before being accepted into the group.
https://www.facebook.com/groups/2454786551255317/

Component values for the PCB as well as some alternate values are listed below. This is a BOM for the PCB only. Resistors and diodes are 6.3mm leg spacing, film and ceramic capacitors are 5.08mm leg spacing, and electrolytic capacitors are 2.54mm leg spacing. I/O jacks, DC jack, switch, enclosure, and knobs are not listed. A drill template is not attached, as this PCB is designed for a variety of installations. When built as a stand-alone pedal, the minimum enclosure size is Hammond 1590B.

Part	Value	Description	substitute	substitution notes
C1	47n	film cap	10n-100n	input cap
C2	270p	ceramic cap	100p-1n	LPF for entire circuit. Higher values will be darker but less prone to oscillation
C3	1u	film cap		
C4	1.5u	film cap		
C5	0.15u	film cap		
C6	6.8n	film cap		
C7	68n	film cap		
C8	0.1u	ceramic cap		
C9	4.7n	film cap		
C10	0.1u	film cap		
C11	470p	ceramic cap	100p-1n	LPF for EQ. Higher values will be darker but less prone to oscillation
C12	100u	electrolytic cap	47u	
C13	100u	electrolytic cap	47u	
D1	1N5818	schottky diode	1n4001, bat41, etc	any protection diode suitable for 9v supply
LED	3mm LED	status LED		
IC1	TL072P	OP AMP	TLE2072	more expensive, more headroom
IC2	TLE2074	OP AMP	TL074, TLC2272	less expensive, less headroom
CLR	4.7k	1/4 watt resistor	2k-10k	current limiting resistor for LED
R1	1M	1/4 watt resistor	2.2M	pull down resistor
R2	10k	1/4 watt resistor	bigger	if more headroom is required
R3	1M	1/4 watt resistor	smaller	if more headroom is required
R4	33k	1/4 watt resistor	bigger	if more output is required
R5	10k	1/4 watt resistor	bigger	for less headroom
R6	4.7k	1/4 watt resistor	bigger	for more headroom
R7	330R	1/4 watt resistor		
R8	330R	1/4 watt resistor	270R	when also substituting R10 for 120k, produces a wider low mid cut
R9	82k	1/4 watt resistor	100K	for Digitech DPS1550 style. Lowers center frequency of mid band
R10	100k	1/4 watt resistor	120k	when also substituting R18 for 270R, produces a wider low mid cut
R11	10k	1/4 watt resistor		
R12	100k	1/4 watt resistor		
R13	10K	1/4 watt resistor		
R14	10k	1/4 watt resistor		
R15	330R	1/4 watt resistor		
R16	100k	1/4 watt resistor		
R17	10k	1/4 watt resistor		
EQ	A5K	16mm pot		
S	pad	send to PCB		
L+	pad	LED+		
L-	pad	LED-		
R	pad	return from PCB		
V	pad	9v input		
G	pad	ground		


God City Instruments
Murdock V1.1
Kurt Ballou 2019
VR
VR
VR
R3
1M
10k
R5
S
47n
C1
10k
R2
IC1A
TL072P
4.7k
R6
IC2D
TLE2074
10k
R14
IC1B
TL072P
C3
1u
R13
10K
R
R1
1M
GND
C11
470p
270p
C2
33k
R4
100k
R12
GND
C7
68n
100k
R10
IC2B
TLE2074
330R
R8
low
1.5u
C4
A5K
EQ
C9
4.7n
100k
R16
IC2C
TLE2074
330R
R15
high
C10
0.1u
C6
6.8n
82k
R9
IC2A
TLE2074
330R
R7
mid
C5
0.15u
VR
VA
VR
VA
1N5818
V
D1
C12
100u
R11
10k
0.1u MLCC
C8
R17
10k
C13
100u
LED1
LED3MM
4.7k
CLR
G
GND
L-
L+