

University of Pécs
Faculty of Engineering and Information Technology



Design and Production Technology Project:
Klon Centaur Guitar Pedal

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Klon Centaur Project

1. Project Task

I chose this project because the Klon Centaur is a legendary pedal due to its rareness. It's not a simple overdrive; its design is famous for being complex and the "mystery" of it. The creator used resin to hide the circuit so it was discovered years later. It will be covered:

- Dual-Rail Power Supply: Analyzing how a charge pump (the 7660S chip) converts the 9V supply to a higher-voltage rail (near 18V) for greater dynamic headroom.
- Signal Blending: Studying how the circuit splits and then mixes the clean guitar signal with the saturated signal, which defines its unique sound.
- Quality Buffer: Understanding the design of its famous input buffer, which is an integral part of its sound.

This circuit is used as an effects pedal for electric guitar, used primarily as a low-to-medium gain overdrive or as a clean boost. It adds harmonic saturation and sustain to the tone or to simply increase the signal's volume to "push" an amplifier into saturation, all while not drastically altering the instrument's fundamental character.

This design helps and "solves" two problems for guitarists:

- The "Coloration" of Other Pedals: Unlike many overdrives that compress the signal, cut low-end and impose a strong mid-range "hump". The Klon pedal was designed to be "transparent". It solves the problem of how to add gain and saturation without losing the original character and bass response of the guitarist's tone.
- Signal Degradation (Tone Suck): The circuit includes a buffer that solves the high-end frequency loss (known as tone suck) that occurs when using long cables or multiple pedals in a chain. This pedal preserves its integrity and clarity.

2. List of Requirements

Functional Requirements

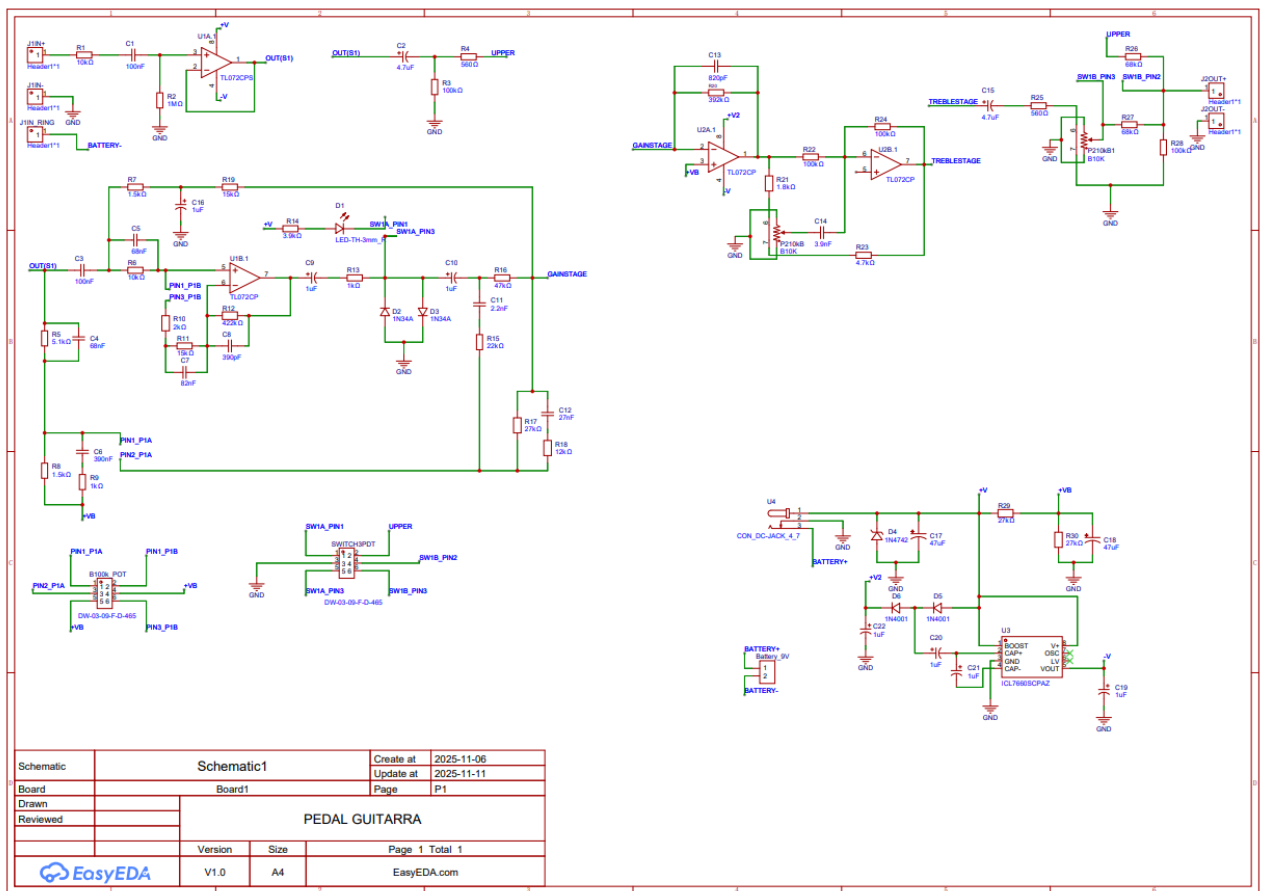
- Primary Function: The device must function as a "transparent" overdrive and clean boost pedal for electric guitar.
- Controls: The user must be able to control three parameters via panel-mounted knobs:
 - Gain: Controls both the amount of saturation and the blend of the clean/dirty signal.

- Treble: Adjusts the high-frequency content of the output signal.
- Output: Controls the overall master volume level of the pedal.
- Switching: The pedal must feature a true-bypass footswitch (3PDT) that allows the signal to pass through the circuit unaffected when the pedal is off.
- Indicator: A panel-mounted LED must clearly indicate when the effect is active.

Technical Characteristics

- Power Input: The circuit must be powered by a standard 9V DC power supply (center-negative) or a 9V battery.
- Internal Voltage: The circuit must use a charge pump (ICL7660S) to generate a higher internal voltage (approx. +18V and -8.4V) to power the op-amps, ensuring high dynamic range (headroom).
- Gain Control: The "Gain" knob must be a dual-ganged (stereo) 100k Ω potentiometer, with one gang controlling gain and the other controlling the clean signal blend.
- Audio IN/OUT:
 - Input: One 1/4 TRS (stereo) jack, wired to switch the battery power off when no cable is inserted.
 - Output: One 1/4 TS (mono) jack.
- Component Type: The PCB must be designed using Through-Hole (THT) components for all resistors, capacitors, ICs and diodes.
- Enclosure: The final circuit must be housed in a durable metal enclosure with all controls and jacks secured to the chassis.

3. Schematic

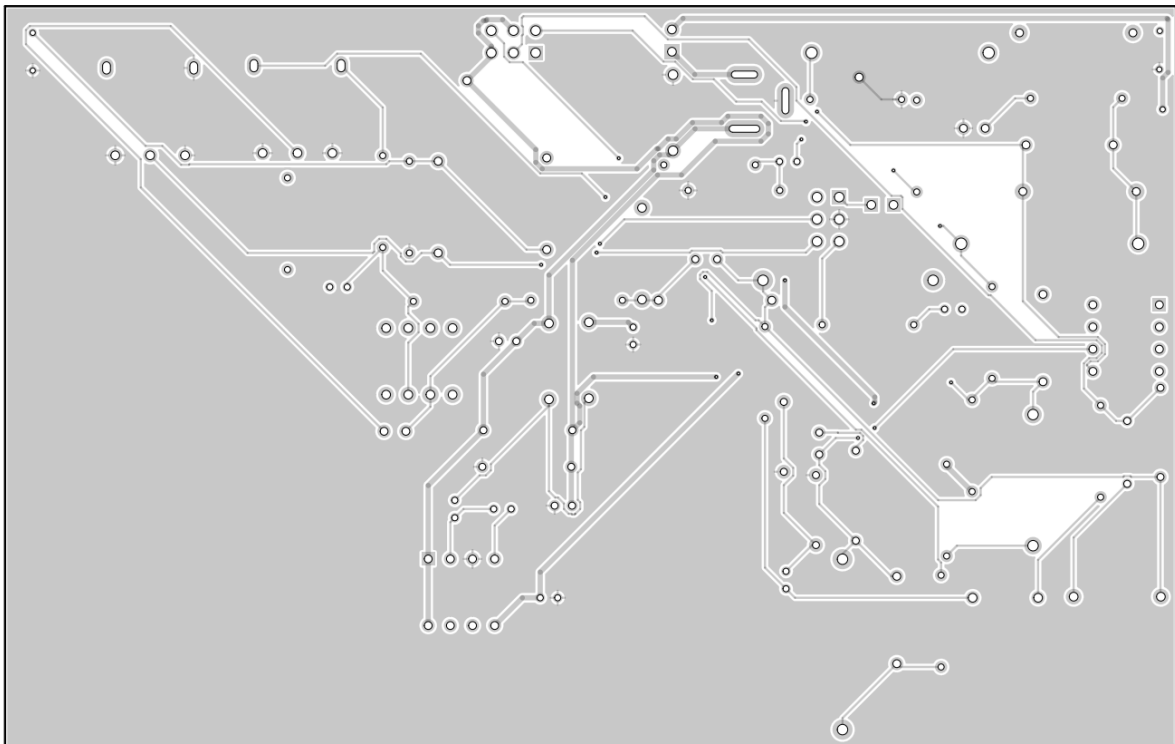
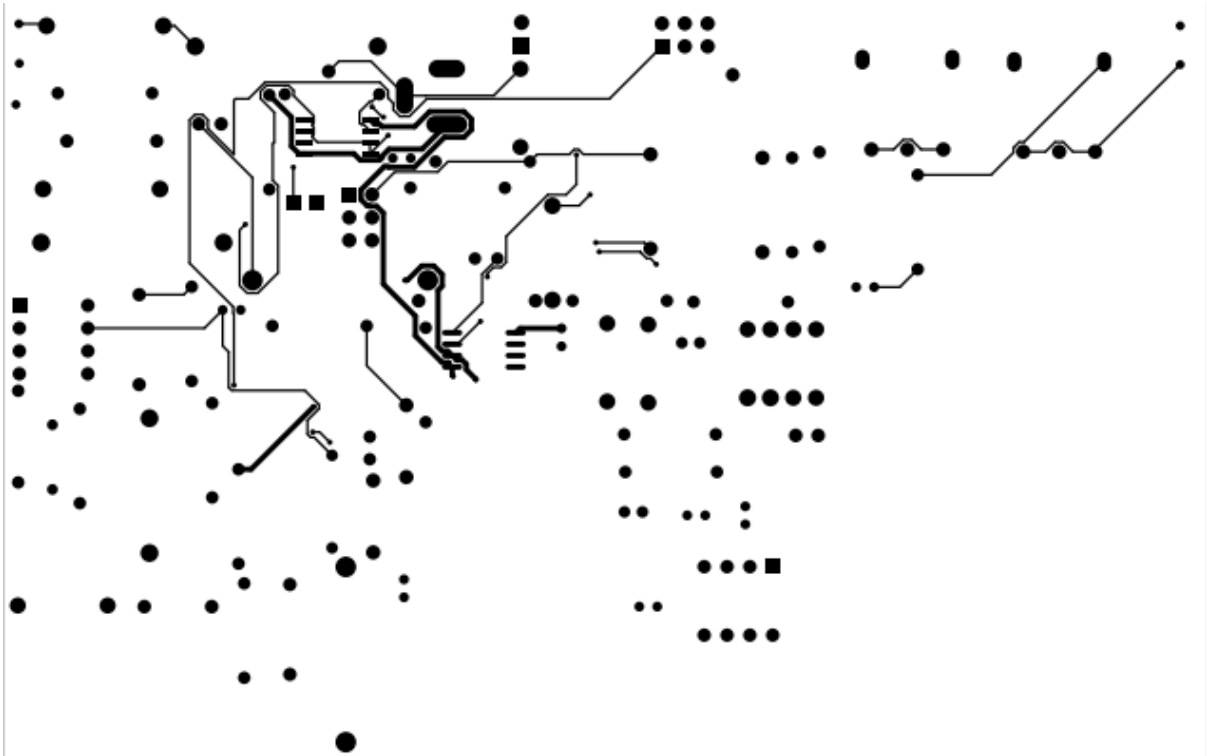


4. Bill of Materials (BOM)

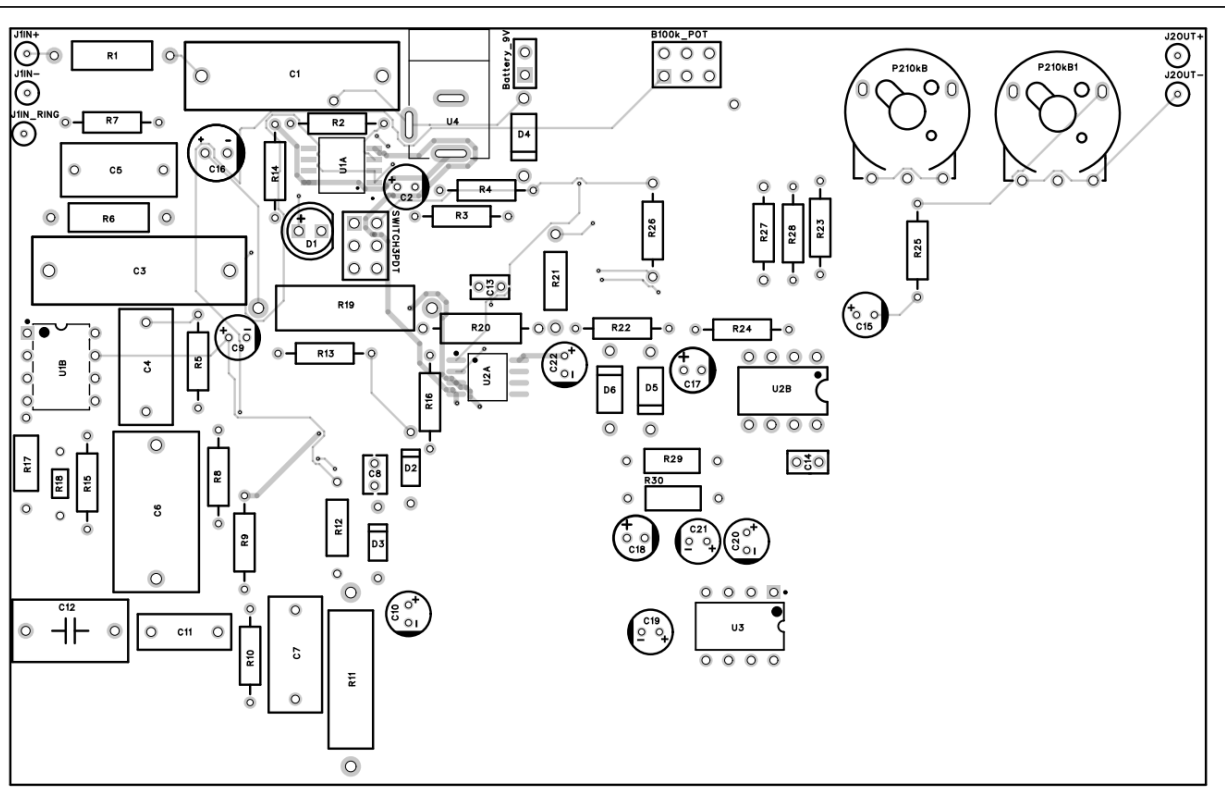
No.	Quantity	Comment	Designator	Footprint	Value	Manufacturer Part
1	2	DW-03-09-F-D-465	B100k_POT_SWITCH3PDT	HDR-TH_ZW-03-11-T-D-670-130		DW-03-09-F-D-465
2	1	2.54-1*2P母	Battery_9V	HDR-TH_2P-P2.54-V-F		2.54-1*2P母
3	2	100nF	C1,C3	CAP-TH_L24.0-W7.6-P20.30-D0.8	100nF	409CE104M275AH22
4	2	4.7uF	C2,C15	CAP-TH_BD5.0-P2.00-D0.5-FD	4.7uF	4.7UF50VC110GF
5	2	68nF	C4,C5	CAP-TH_L13.0-W6.0-P10.00-D1.2	68nF	B32921C3683M289
6	1	390nF	C6	CAP-TH_L18.0-W9.5-P15.00-D1.2	390nF	MP2394K27D5X8LC
7	1	82nF	C7	CAP-TH_L13.0-W6.0-P10.00-D1.2	82nF	MP2823K27C3R6LC
8	1	390pF	C8	CAP-TH_L4.0-W2.5-P2.50-D0.5	390pF	FA18C0G2A391JNU00
9	6	1uF	C9,C10,C19,C20,C21,C22	CAP-TH_BD5.0-P2.00-D0.5-FD-1	1uF	50V1uF_CD110
10	1	2.2nF	C11	CAP-TH_L10.5-W4.0-P7.50-D0.6	2.2nF	C42Q2222K30C000
11	1	27nF	C12	CAP-TH_L13.0-W7.0-P10.00-D0.6	27nF	MMKP27J3JA1001
12	1	820pF	C13	CAP-TH_L4.0-W2.5-P2.50-D0.5	820pF	FK18C0G1H821J
13	1	3.9nF	C14	CAP-TH_L4.5-W2.5-P2.50-D0.5	3.9nF	FK14C0G1H392J
14	1	1uF	C16	CAP-TH_BD6.3-P2.50-D0.5-FD	1uF	1uF450V6.3x12KM
15	2	47uF	C17,C18	CAP-TH_BD5.0-P2.00-D0.8-FD	47uF	NXA25V47M5*11 LO
16	1	LED-TH-3mm_R	D1	LED-TH_BD5.4-P2.54-FD_RED		LED-TH-3mm_R
17	2	1N34A	D2,D3	DO-35_BD2.0-L4.0-P8.0-D0.5-RD		1N34A
18	1	1N4742	D4	DO-41_BD2.4-L4.7-P8.70-D0.8-FD		1N4742
19	2	1N4001	D5,D6	DO-41_BD2.4-L4.7-P8.70-D0.9-RD		1N4001
20	5	Header1*1	1IN+,11IN-,11IN_RING,J2OUT+,J2OUT	CONN-TH_HEADER		Header1*1
21	2	B10K	P210kB,P210kB1	RES-ADJ-TH_BK10		B10K
22	2	10kΩ	R1,R6	RES-TH_BD3.2-L9.0-P13.00-D0.5	10kΩ	CF1/2W-10KΩ±5%T52
23	1	1MΩ	R2	RES-TH_BD2.3-L6.5-P10.50-D0.5	1MΩ	CF1/4W-1MΩ±5% T
24	4	100kΩ	R3,R22,R24,R28	RES-TH_BD2.3-L6.5-P10.50-D0.5	100kΩ	CF1/4W-100KΩ±5%T52
25	2	560Ω	R4,R25	RES-TH_BD2.3-L6.5-P10.50-D0.5	560Ω	CF1/4W-560Ω±5%T52
26	1	5.1kΩ	R5	RES-TH_BD2.3-L6.5-P10.50-D0.5	5.1kΩ	CF1/4W-5.1KΩ±5% T
27	2	1.5kΩ	R7,R8	RES-TH_BD2.3-L6.5-P10.50-D0.5	1.5kΩ	CF1/4W-1.5KΩ±5% T
28	2	1kΩ	R9,R13	RES-TH_BD2.3-L6.5-P10.50-D0.5	1kΩ	CF1/4W-1KΩ±5%T52
29	1	2kΩ	R10	RES-TH_BD2.3-L6.5-P10.50-D0.5	2kΩ	MF1/4W-2KΩ±1%T52
30	2	15kΩ	R11,R19	RES-TH_BD5.0-L15.5-P19.50-D0.7	15kΩ	CF3WS-15KΩ±5%T
31	1	422kΩ	R12	RES-TH_BD2.4-L6.3-P10.30-D0.6	422kΩ	HHV-25FR-52-422K
32	1	3.9kΩ	R14	RES-TH_BD2.3-L6.5-P10.50-D0.5	3.9kΩ	CF1/4W-3.9KΩ±5% T
33	1	22kΩ	R15	RES-TH_BD2.3-L6.5-P10.50-D0.5	22kΩ	CF1/4W-22KΩ±5% T
34	1	47kΩ	R16	RES-TH_BD2.3-L6.5-P10.50-D0.5	47kΩ	CF1/4W-47KΩ±5% T
35	3	27kΩ	R17,R29,R30	RES-TH_BD2.7-L6.2-P10.20-D0.4	27kΩ	CR1/4W-27K±5%-ST26
36	1	12kΩ	R18	RES-TH_BD1.8-L3.2-P7.20-D0.4	12kΩ	MF1/8W-12KΩ±1%T52
37	1	392kΩ	R20	RES-TH_BD3.3-L9.0-P13.00-D0.6	392kΩ	HHV-50FB-52-392K
38	1	1.8kΩ	R21	RES-TH_BD2.5-L6.5-P10.50-D0.6	1.8kΩ	CF1/4W-1.8KΩ±5%T52
39	1	4.7kΩ	R23	RES-TH_BD2.3-L6.5-P10.50-D0.5	4.7kΩ	MF1/4W-4.7KΩ±1% T
40	2	68kΩ	R26,R27	RES-TH_BD2.2-L6.5-P10.50-D0.6	68kΩ	MF1/4W-68KΩ±1% T
41	1	TL072CPS	U1A	SO-8_L6.2-W5.3-P1.27-LS7.8-BL		TL072CPS
42	1	TL072CP	U1B	DIP-8_L9.6-W6.4-P2.54-LS7.6-BL-1		TL072CP
43	1	TL072CP	U2A	SOIC-8_L5.3-W5.3-P1.27-LS8.0-BL		TL072CP
44	1	TL072CP	U2B	PDIP-8_L9.6-W6.4-P2.54-LS7.6-BL		TL072CP
46	1	CON_DC-JACK_4_7	U4	DC-IN-TH_CON_DC-JACK_4_7		CON_DC-JACK_4_7
45	1	ICL7660SCPAZ	U3	DIP-8_L9.8-W6.6-P2.54-LS7.6-BL		ICL7660SCPAZ
PCB TOTAL						
46	1	Battery Connector 9V	6F22 connector	x	x	x
47	1	100kΩ Potentiometer	P1	x	x	x
48	1	3PDT-M12	SW1	x	x	x
49	1	ACA-117	JACK IN	6.3 mm jack socket, stereo, built-in.	x	x
50	1	ACA-116	Jack OUT	6.3 mm jack socket, mono, built-in	x	x
51	1	Enclosure	x	x	x	x
52	4	Screws	x	x	x	x

Manufacturer	Supplier Part	Supplier	Price
SAMTEC	C6023660	LCSC	
BOOMELE(博穆精密)	C49661	LCSC	
KEMET(基美)	C3152843	LCSC	
Econd(米朗?子)	C46867052	LCSC	
TDK	C125427	LCSC	
SRD(?融?)	C135696	LCSC	
SRD(?融?)	C105862	LCSC	
TDK	C1631289	LCSC	
HRK(?瑞??子)	C2960204	LCSC	
faratronic(厦?法拉)	C5121900	LCSC	
KYET(科雅)	C557502	LCSC	
TDK	C3694779	LCSC	
TDK	C6197506	LCSC	
Econd(米朗?子)	C49304904	LCSC	
AMYOUNG(??三?)	C346942	LCSC	
	C9900003210	LCSC	
	C13769	LCSC	
LGE(?光)	C5174492	LCSC	
	C82804	LCSC	
	C9900168886	LCSC	
	C2839839	LCSC	
?星机?	C714352	LCSC	
CCO(千志?子)	C120127	LCSC	
?星机?	C714328	LCSC	
?星机?	C714295	LCSC	
CCO(千志?子)	C120072	LCSC	
CCO(千志?子)	C120059	LCSC	
?星机?	C714300	LCSC	
?星机?	C714001	LCSC	
?星机?	C714383	LCSC	
YAGEO(国巨)	C1762464	LCSC	
CCO(千志?子)	C120069	LCSC	
CCO(千志?子)	C120087	LCSC	
CCO(千志?子)	C120095	LCSC	
VO(翔胜)	C2894621	LCSC	
?星机?	C713920	LCSC	
YAGEO(国巨)	C1390370	LCSC	
?星机?	C714304	LCSC	
CCO(千志?子)	C119339	LCSC	
CCO(千志?子)	C119365	LCSC	
TI(德州?器)	C2868600	LCSC	
TI(德州?器)	C7236	LCSC	
TI(德州?器)	C2059291	LCSC	
Y MOSFET(????子)	C48677901	LCSC	
	C9900003943	LCSC	
RENESAS(瑞?)/IDT	C13725	LCSC	
			559.00 Ft
x	x	HESTORE	188.00 Ft
x	x	HESTORE	272.00 Ft
x	x	HESTORE	992.00 Ft
x	x	HESTORE	829.00 Ft
x	x	HESTORE	272.00 Ft
x	x	LCSC	1,732.00 Ft
x	x	x	150.00 Ft
		TOTAL PRICE:	4,994.00 Ft

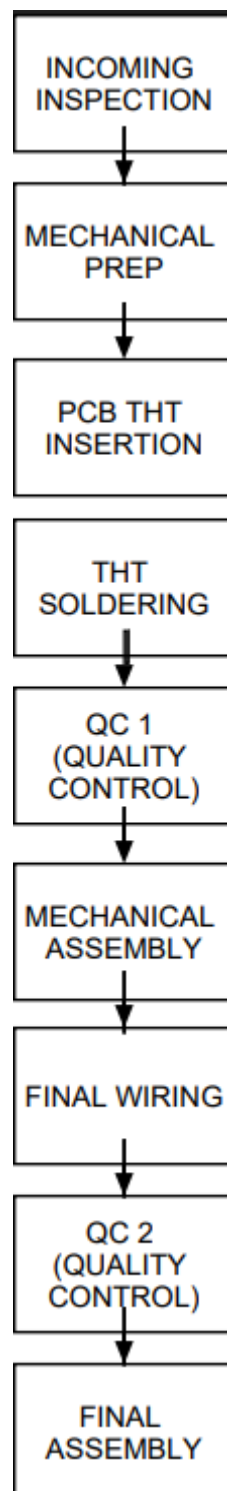
5. PCB LAYOUT



6. INSERTION DRAWING



7. FLOW CHART



It consists of 9 steps:

1. Incoming Inspection: Receive kit. Check all components against the BOM (PCB, THT components, enclosure)
2. Mechanical Preparation: Drill the enclosure based on the Box Design.

3. PCB THT Insertion: Manual insertion of all THT components (Resistors, Capacitors, Diodes, IC Sockets) into the PCB, here we will be following the Insertion Drawing
4. THT Soldering: Manual soldering of all THT components.
5. Quality Control 1: Visual Inspection of the PCB. Check for solder bridges, cold joints and correct component orientation for ICs and Diodes.
6. Mechanical assembly: Mount off board components into the enclosure (Potentiometers, Footswitch, Audio/DC Jacks, LED).
7. Final Wiring: Solder wires from the PCB (using the Headers/Pads) to the off board components.
8. Quality Control 2: Functional Test (FNT). Connect power, guitar and amplifier. Test all controls (Gain, Treble, Output) and footswitch function.
9. Final Assembly: Close the enclosure with the 4 screws and attach knobs.

8. FMEA (Failure Mode and Effect Analysis)

- Process Step 4: THT SOLDERING

- Analysis: This step analyzes the risks of manually soldering the Through-Hole (THT) components to the PCB.

Potential Failure Mode	Potential Effect(s) of Failure	S (Sev)	Potential Cause(s) of Failure	O (Occ)	Current Process Control(s)	D (Det)	RPN (SOD)	Recommended Action(s)
Reversed Polarity on IC	Functional Fault. The IC will be destroyed. No +V/-V generation. The pedal will not power on.	9	Operator carelessness/error: The Insertion Drawing is misread.	3	QC 1: Visual Inspection (Step 5). The operator checks for component orientation.	3	81	Use IC Sockets for all ICs. This allows the IC to be inserted in the correct orientation after soldering, without heat damage.
Solder Bridge (Short circuit between adjacent IC pins)	Functional Fault. The circuit will malfunction or short-circuit the power supply when turned on.	8	Operator error: Too much solder applied.	4	QC 1: Visual Inspection (Step 5). The operator checks for bridges.	2	64	Use flux. Before QC 1, use a multimeter in continuity mode to check between adjacent power (+V/-V) and GND pins.

- Process Step 7: FINAL WIRING
 - Analysis: This step analyzes the risks of manually soldering wires from the PCB to the off-board components (Jacks, Footswitch, battery connection, etc.).

Potential Failure Mode	Potential Effect(s) of Failure	S (Sev)	Potential Causes of Failure	O (Occ)	Current Process Control (s)	D (Det)	RPN (SOD)	Recommended Action(s)
Mis-wired 3PDT Footswitch (Input/Output reversed)	Functional Fault: The pedal will not bypass correctly (no sound when off) or will not engage the effect (no sound when on).	8	High complexity (9 lugs). Operator confusion.	4	QC 2: Functional Test (FNT) (Step 8).	1	32	Create a clear, color-coded wiring diagram before starting this step. Use different colored wires for IN, OUT, +V and GND.
Reversed Polarity on DC Jack	Functional Fault: The circuit will not power on. If Diode D3 fails, this could destroy all ICs.	9	Operator error. Misidentification of the jack's lugs.	2	QC 2: Functional Test (FNT) (Step 8).	1	18	Test the DC Jack with a multimeter before soldering it to the PCB to confirm which lug is Positive and which is GND..

9. Control Plan (CP)

Process step 5 on flowchart: QC 1 (Visual Inspection)

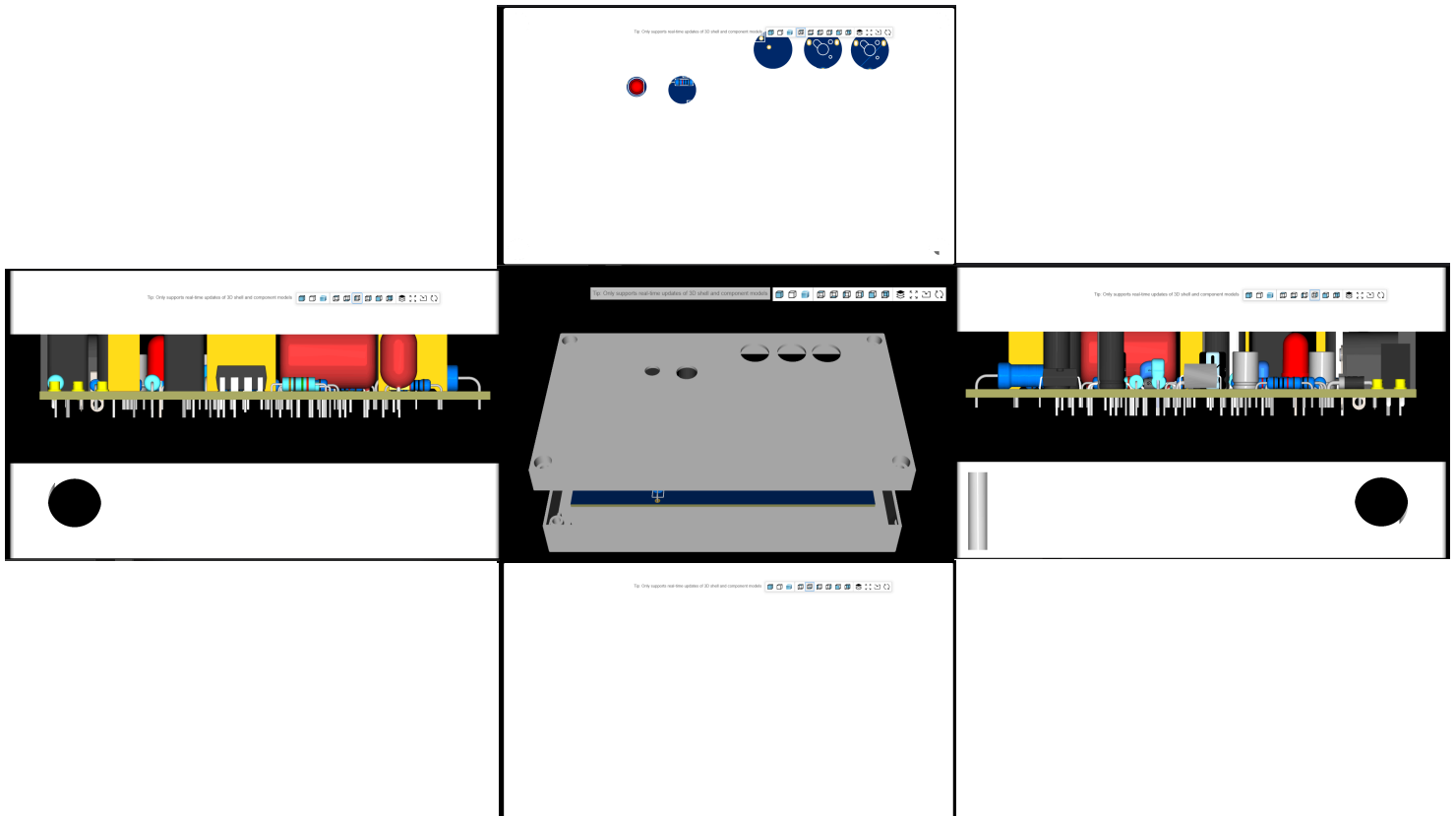
- Characteristic:
 - THT Component Polarity.
 - Solder Joint Quality.
- Specification / Tolerance:
 - All polarized components must match the Insertion Drawing (Point 6).
 - No solder bridges or cold joints.
- Evaluation Method / Technique:
 - AOI (Automated Optical Inspection) or magnified Visual Inspection.
- Sample (Size & Frequency):
 - Size: 5 pcs
 - Frequency: Once per hour, if we use AOI it would be a 100%.
- Reaction Plan:
 - If a defect is found in the sample, stop the line.
 - Place all products built since the last good check on hold.
 - Notify the Process Engineer to fix the root cause
 - Inspect all products on hold.

Process Step 8 from flowchart: QC 2 (Functional Test)

- Characteristic:
 - IC Power Supply Voltages.
 - Functional operation of all controls.
- Specification / Tolerance:
 - IC pins must show correct $+V = 18V$ and $-V = -8.4V$ readings.
 - All controls (Gain, Treble, Output, Switch) must function correctly.
- Evaluation Method / Technique:
 - Automated Test Jig that checks voltages and audio signal path.
- Sample (Size & Frequency):
 - Size: 1 piece
 - Frequency: 100%
- Reaction Plan:
 - The unit fails the test and is sent to the Repair station with a failure report.
 - If 3 units in a row fail with the same defect, stop the line and notify the Process Engineer

10. Box Design

Sides and top/bottom view



11. References

- a. Chittum, M. (2009, April 15). *Centaur Klon schematic S698* [Schematic diagram]. Freestompboxes.org Online Community. <http://freestompboxes.org>
- b. ElectroSmash. (2018, October 24). *Klon Centaur analysis*. <https://www.electrosmash.com/klon-centaur-analysis>
- c. Guitar Gear Finder. (n.d.). *How to build a Klon Centaur clone from a kit (step-by-step tutorial)*. Retrieved November 15, 2025, from <https://guitargearfinder.com/guides/build-klon-centaur-clone-kit/>