Opamp Inverting Amplifier

PART NUMBER	04A-005
GROUP NAME	Opamp Amplifiers (04A)
CIRCUIT NAME	Inverting Amplifier
VARIANT DESCRIPTION	Single supply, DC Bias Trimmer
BOARD DESIGN	PCB50
PRODUCT DESCRIPTION	Panel of 04A-005 miniPCBs, v-scored (1 Panel = 4 Pieces)

Basic Circuit Diagram

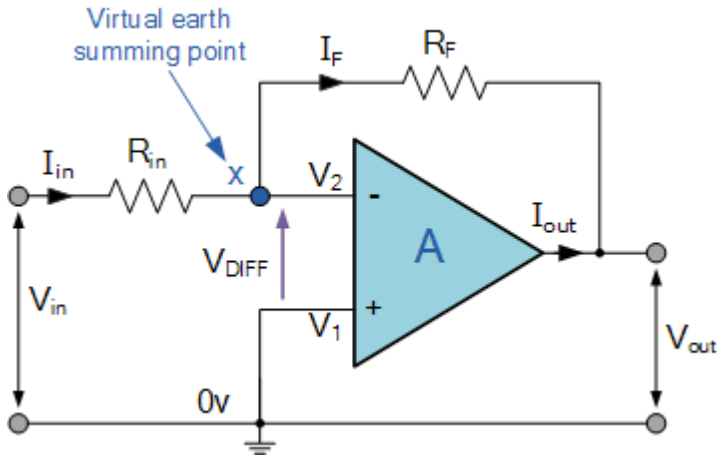
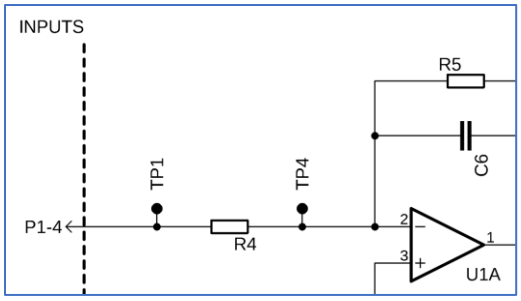


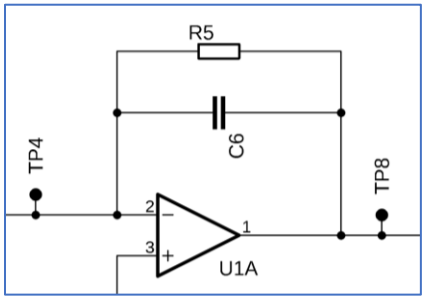
Figure 1 – Source: https://www.electronics-tutorials.ws/opamp/opamp_2.html

Theory of Operation

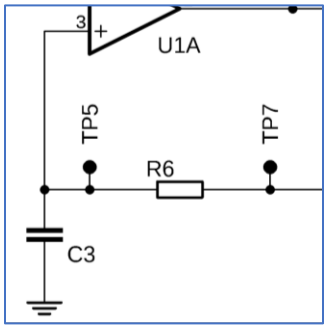
This circuit amplifies a voltage signal. Since there is no DC blocking capacitor on the signal input pin P1-4, the DC voltage difference between pin P1-4 and the reference voltage set by the trimmer potentiometer R2 will be amplified.



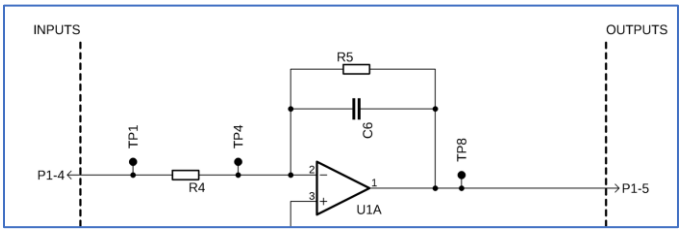
The feedback capacitor C6 allows larger feedback resistor values to be used without decreasing the amplifier's gain bandwidth.



A low-pass Butterworth filter is formed by resistor R6 and capacitor C3 to minimize noise on the non-inverting opamp input.

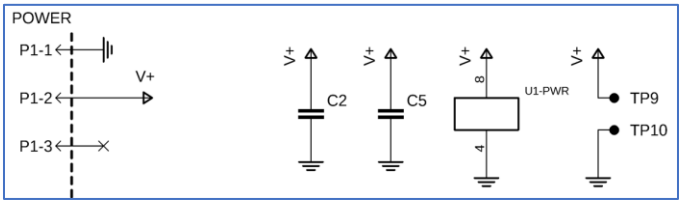


The input impedance is largely determined by resistor R4. The output impedance is largely determined by opamp U1.



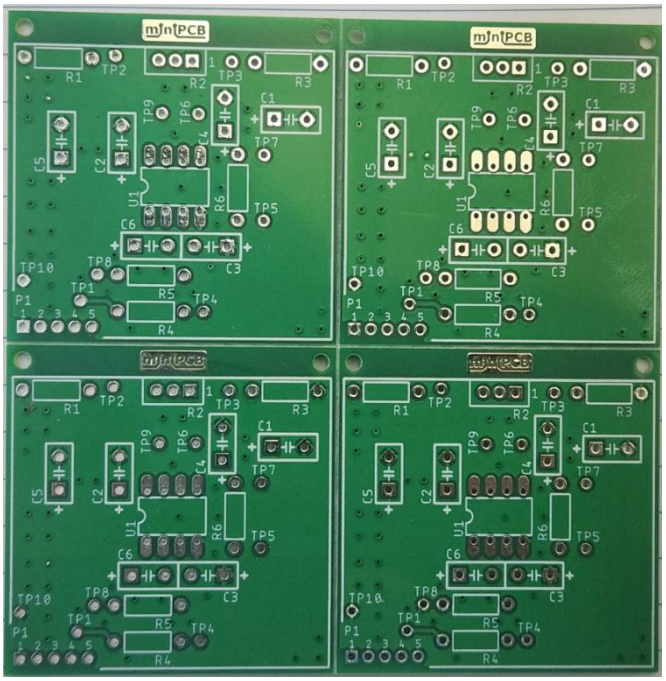
The minimum and maximum supply voltage is largely determined by opamp U1. Only the V+ power source is needed to operate this circuit.

Capacitors C2 and C5 filter the V+ power rail. Using capacitors with different values, generally between 10X and 1000X different, will provide better performance than two capacitors with similar values. Using low noise dielectric capacitors are recommended.

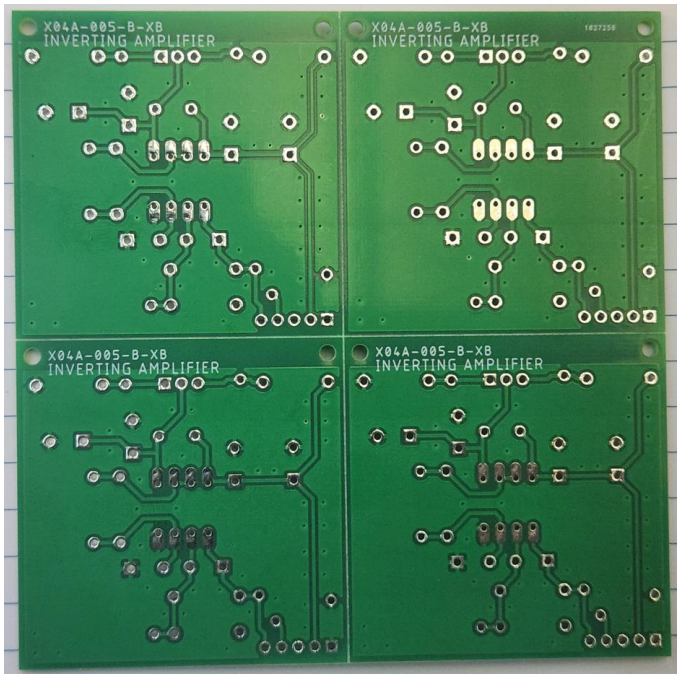


Panel Board

These pictures do not reflect the current Gerber files.

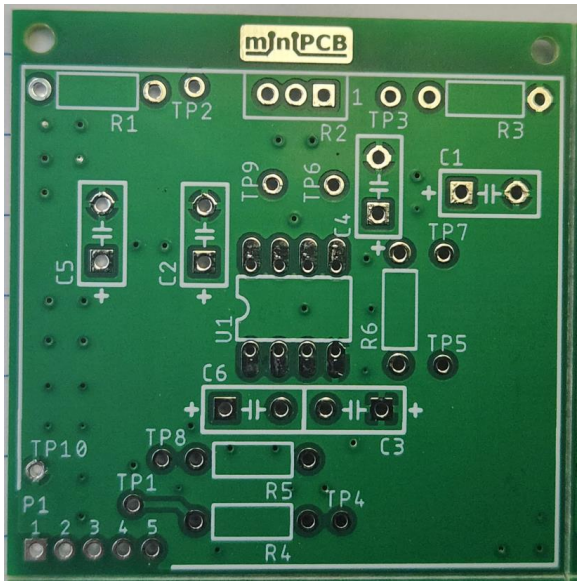


TOP VIEW

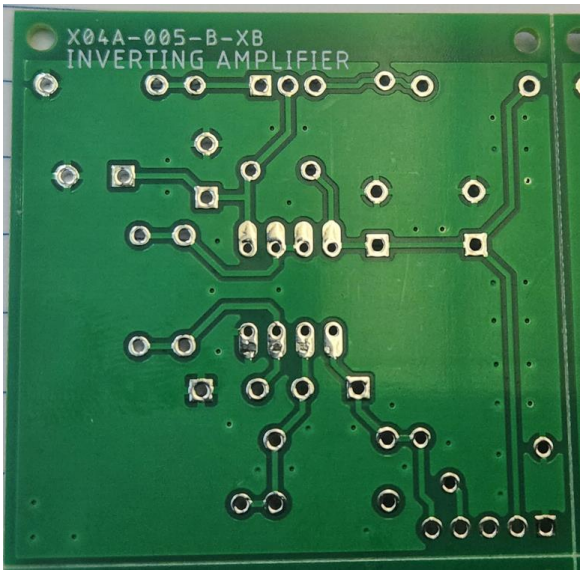


BOTTOM VIEW

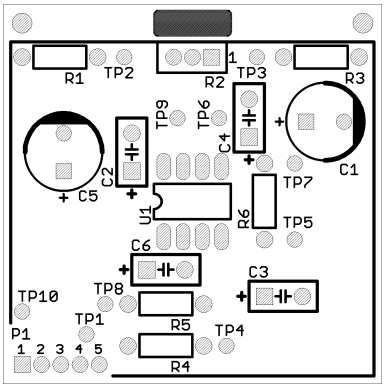
Single Board



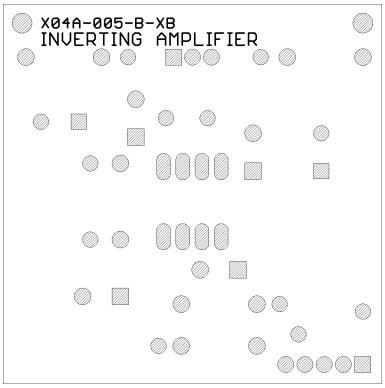
TOP VIEW



BOTTOM VIEW

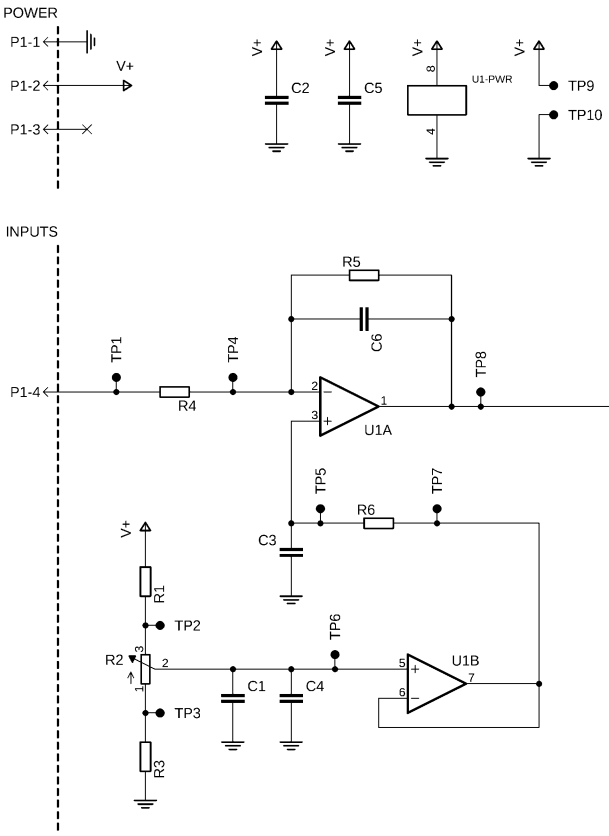


TOP VIEW



BOTTOM VIEW

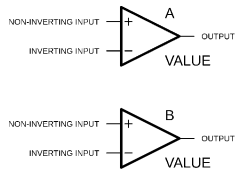
REV	DESCRIPTION	ECO	DATE
B	INITIAL RELEASE	1002	



DUAL OPAMP

SOIC8, DIP8

SCHEMATIC SYMBOL



PINOUT

PIN	DESCRIPTION
1	OUTPUT, A
2	INVERTING INPUT, A
3	NON-INVERTING INPUT, A
4	-V SUPPLY
5	NON-INVERTING INPUT, B
6	INVERTING INPUT, B
7	OUTPUT, B
8	+V SUPPLY

TITLE
INVERTING AMPLIFIER

DATETIME STAMP
1/16/2023 8:25 PM

PRINTED CIRCUIT BOARD
OPERATIONAL AMPLIFIER
DUAL OPAMP CIRCUIT
SINGLE SUPPLY, DC BIAS TRIMMER

DR	DATE
NM	02SEP2022
ENG	DATE
QA	DATE

SIZE	DWG NO	REV
A	04A-005	B
SCALE NONE	SHEET 1/1	

Design Example

Parts List

QTY REQ	PART	REF DES	MFG	MFG PN	VALUE	FIND
1	PCB	-	miniPCB	04A-005	N/A	1
1	CAPACITOR	C1	NICHICON	UFW2A470MPD	47 uF	2
1	CAPACITOR	C2	TDK	FA28X7S2A473KRU06	47 nF	3
1	CAPACITOR	C3	TDK	FA28X7S2A473KRU06	47 nF	4
1	CAPACITOR	C4	TDK	FA28X7S2A473KRU06	47 nF	5
1	CAPACITOR	C5	NICHICON	UFW2A470MPD	47 uF	6
1	CAPACITOR	C6	TDK	FA24NP02W102JNU06	1000pF	7
1	PINS, 2mm	P1	MOLEX	87754-0552	N/A	8
1	RESISTOR	R1	VISHAY	RL07S101GRE6	100 Ω	9
1	TRIMMER	R2	VISHAY	T93YA104KT20	100 KΩ	10
1	RESISTOR	R3	VISHAY	RL07S101GRE6	100 Ω	11
1	RESISTOR	R4	VISHAY	PTF6550R000BYEK	50 Ω	12
1	RESISTOR	R5	VISHAY	PTF56500R00BYEB	500 Ω	13
1	RESISTOR	R6	VISHAY	RL07S101GRE6	100 Ω	14
1	OPAMP, DUAL	U1	NISSHINBO	NJM2904D	N/A	15
			NISSHINBO	NJM14558D		
			TAIWAN SEMICONDUCTOR	TS358		
			MICROCHIP	MCP6002-I/P		
			ANALOG DEVICES	AD827JNZ		
			TEXAS INSTRUMENTS	LF412CP		
10	TEST POINT	TP*	KEYSTONE ELECTRONICS	5000	N/A	16

Assembly

I want this section to include step by step pictures of the assembly process.

Capture the imaginations of the readers.

Make it look like I'm having fun.

Testing

Test List

TEST #	TEST NAME	TEST DESCRIPTION
1	+V Bus Short-Circuit	Measure resistance between TP9 and TP10.
2	U1 Pin 2 Short-Circuit	Measure resistance between TP1 and TP10.
3	U1 Pin 1 Short-Circuit	Measure resistance between TP8 and TP10.
4	Resistance Value, R1	Measure resistance between TP9 and TP2.
5	Resistance Value, R2	Measure resistance between TP2 and TP3.
6	Resistance Value, R3	Measure resistance between TP3 and TP10.
7	Resistance Value, R4	Measure resistance between TP1 and TP4.
8	Resistance Value, R5	Measure resistance between TP4 and TP8.
9	Resistance Value, R6	Measure resistance between TP5 and TP7.
10	Capacitance Value, C3	Measure capacitance between TP5 and TP10.
11	Capacitance Value, C1	Measure capacitance between TP6 and TP10.
12	Capacitance Value, C5	Measure capacitance between TP9 and TP10.
13	Capacitance Value, C6	Measure capacitance between TP4 and TP8.
14	Safe Turn-On	Apply power while monitoring current draw.
15	Voltage Adjustment, TP5	Set voltage between TP5 and TP10 to 2.50 V.
16	Standby Power Consumption	Measure power consumption during standby operation.
17	Common-Mode Offset	TBD (Waveforms)
18	Output Voltage Swing	TBD (Waveforms)
19	Output Impedance	TBD (Waveforms)
20	Impulse Response	TBD (Waveforms)
21	Step Response	TBD (Waveforms)
22	BODE Plot	TBD (Waveforms)

Test Results

Test Conclusions

Performance

This section will become whatever makes sense for the circuit. Currently, this is a placeholder table.

POWER REQUIREMENTS

PARAMETER NAME	SYMBOL	UNITS	LOWER LIMIT	TARGET VALUE	UPPER LIMIT
Postive DC Supply	+V	V	3.1	3.3	3.5
Negative DC Supply	-V	V	N/A	N/A	N/A

STIMULI REQUIREMENTS

PARAMETER NAME	SYMBOL	UNITS	LOWER LIMIT	TARGET VALUE	UPPER LIMIT
Maximum Voltage Gain	A_v	$\frac{V}{V}$	9.9	10.0	10.1
Bandwidth	f_{-3dB}	Hz		5 MHz	
Common-Mode Offset	V_{cm}	$\frac{V}{V}$			
Common-Mode Gain	A_{cm}	$\frac{V}{V}$			
Maximum Input Bias Current	I_{bias}	A			
Maximum Phase Shift	ϕ_{max}	°			
Source Impedance	R_s	Ω			

PERFORMANCE CHARACTERISTICS

PARAMETER NAME	SYMBOL	UNITS	LOWER LIMIT	TARGET VALUE	UPPER LIMIT
Quiescient Current	I_q	A	0.01	0.02	0.03
Voltage Gain	A_v	$\frac{V}{V}$		10	
Input Impedance	R_i	Ω		50	
Output Impedance	R_i	Ω		0.001	

Engineering Forms

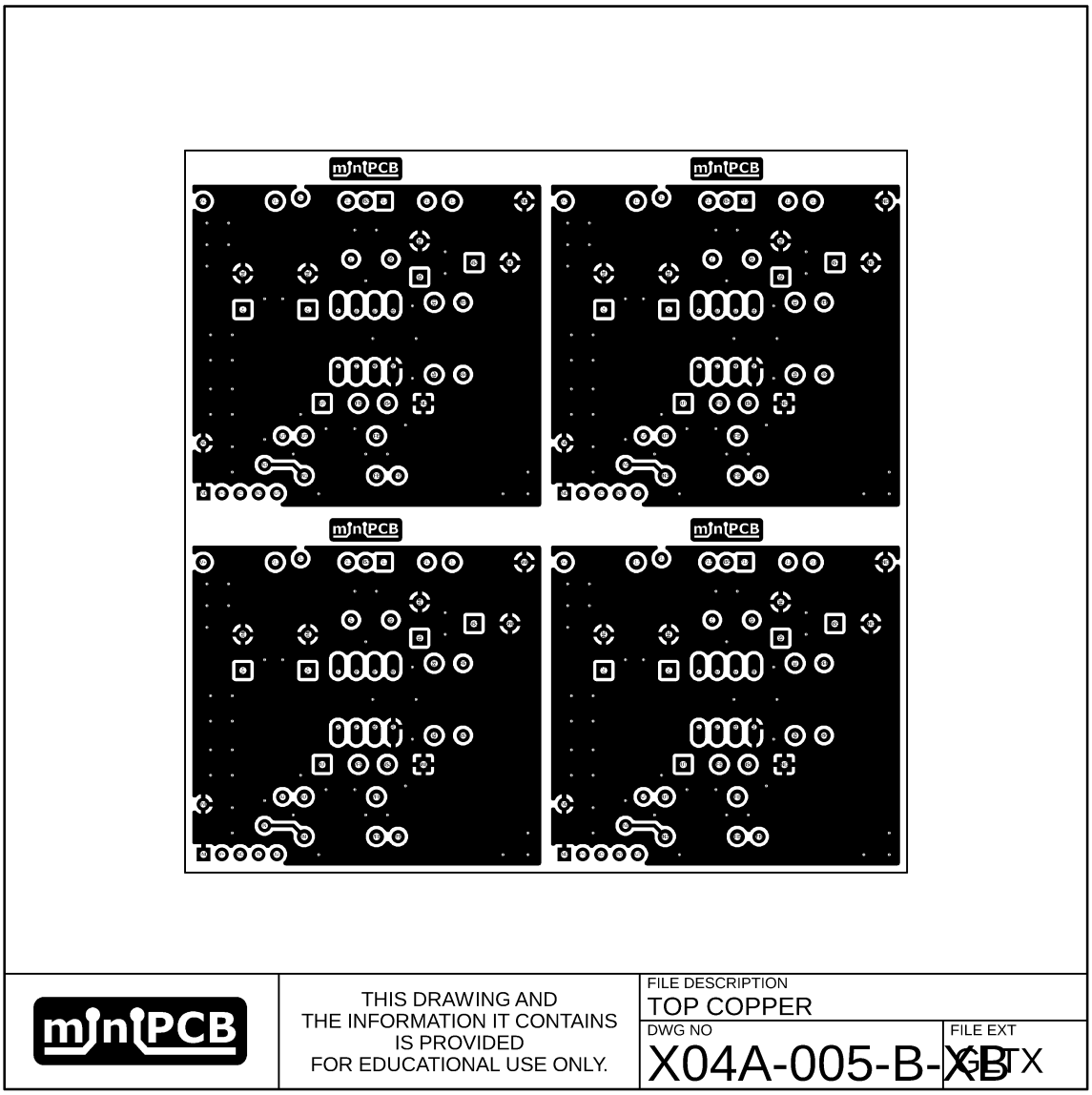
Parts List (FORM)

QTY REQ	PART	REF DES	MFG	MFG PN	VALUE	FIND
1	PCB	-	miniPCB	04A-005	N/A	1
1	CAPACITOR	C1				2
1	CAPACITOR	C2				3
1	CAPACITOR	C3				4
1	CAPACITOR	C4				5
1	CAPACITOR	C5				6
1	CAPACITOR	C6				7
1	PINS, 2mm	P1			N/A	8
1	RESISTOR	R1				9
1	TRIMMER	R2				10
1	RESISTOR	R3				11
1	RESISTOR	R4				12
1	RESISTOR	R5				13
1	RESISTOR	R6				14
1	OPAMP, DUAL	U1			N/A	15
10	TEST POINT	TP*	KEYSTONE ELECTRONICS	5000	N/A	16

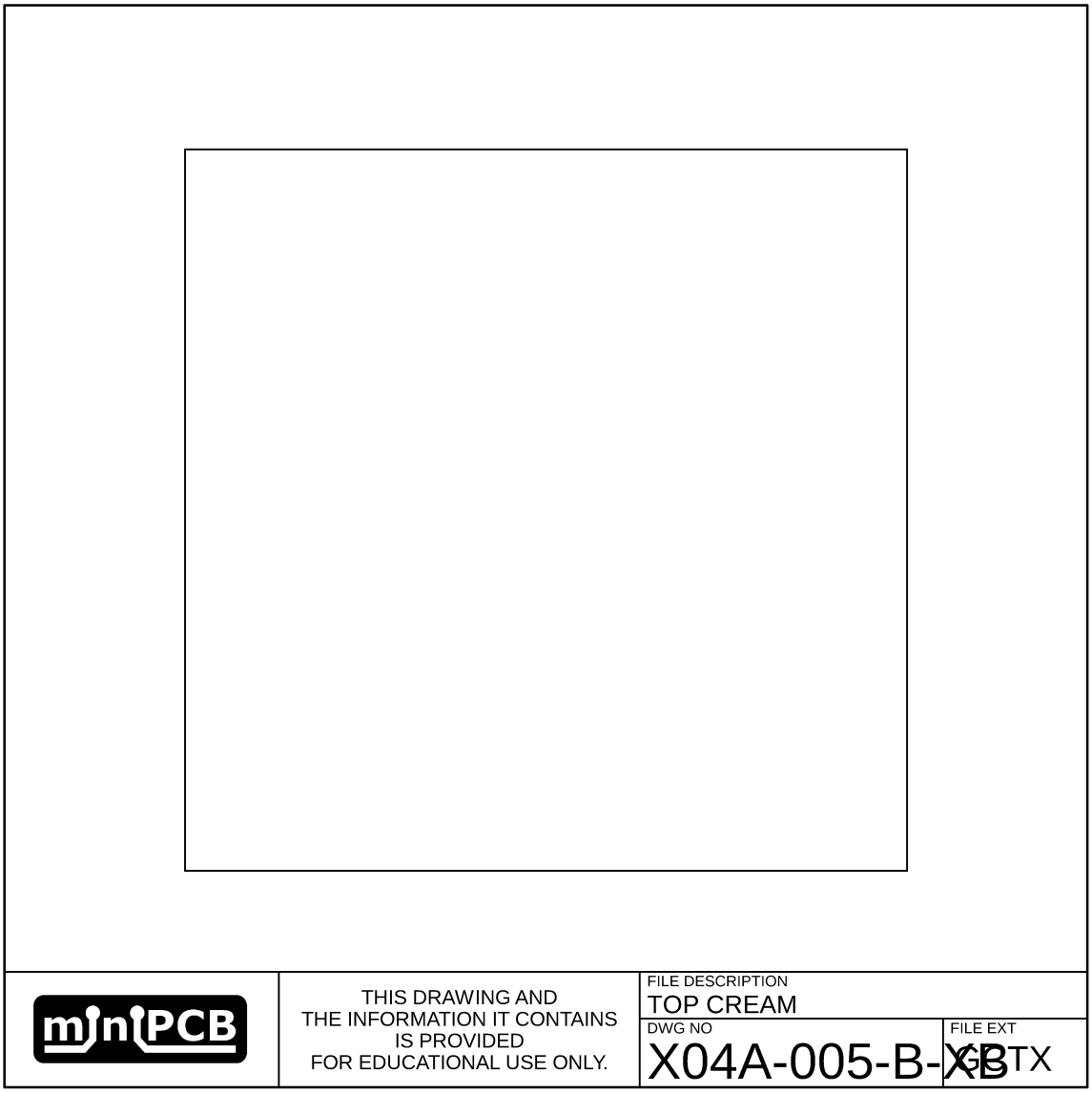
Gerber Files

This section contains images of the layers included in each Gerber file.

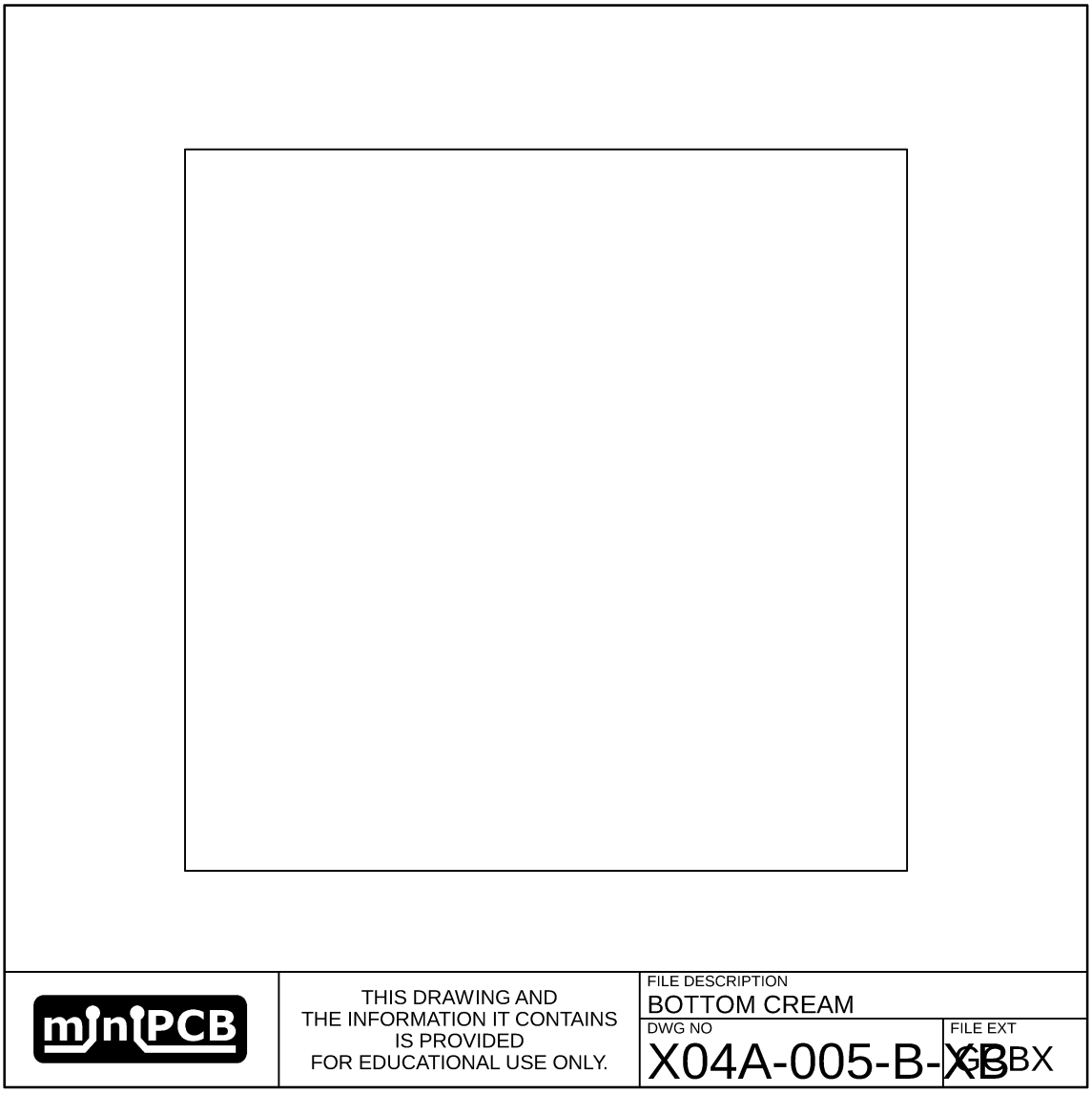
TOP COPPER (GLTX)



TOP CREAM (GCTX)



BOTTOM CREAM (GCBX)



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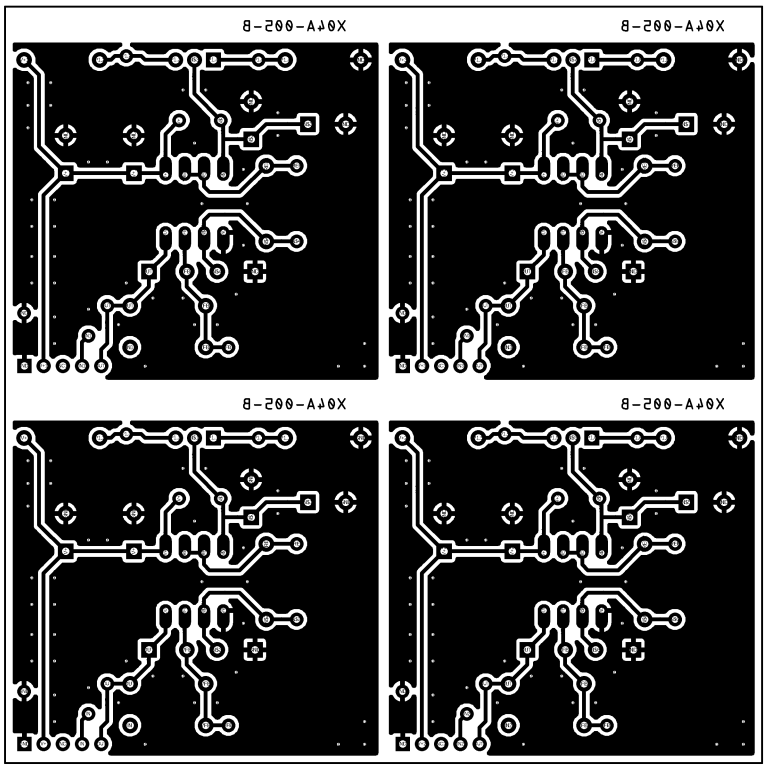
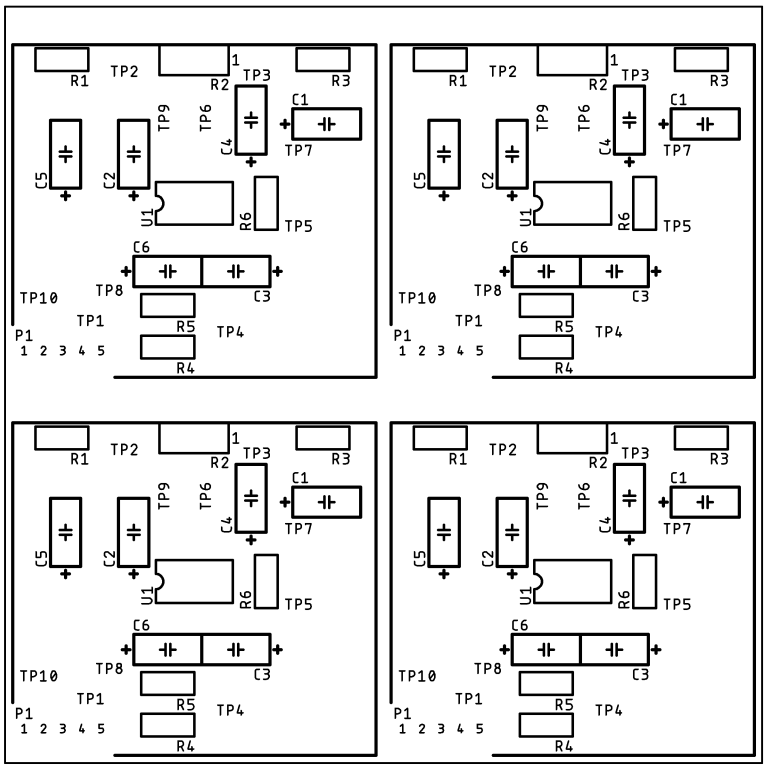


	THIS DRAWING AND THE INFORMATION IT CONTAINS IS PROVIDED FOR EDUCATIONAL USE ONLY.	FILE DESCRIPTION: BOTTOM COPPER DWG NO: X04A-005-B-XB FILE EXT: GBX

TOP SILKSCREEN (GOTX)



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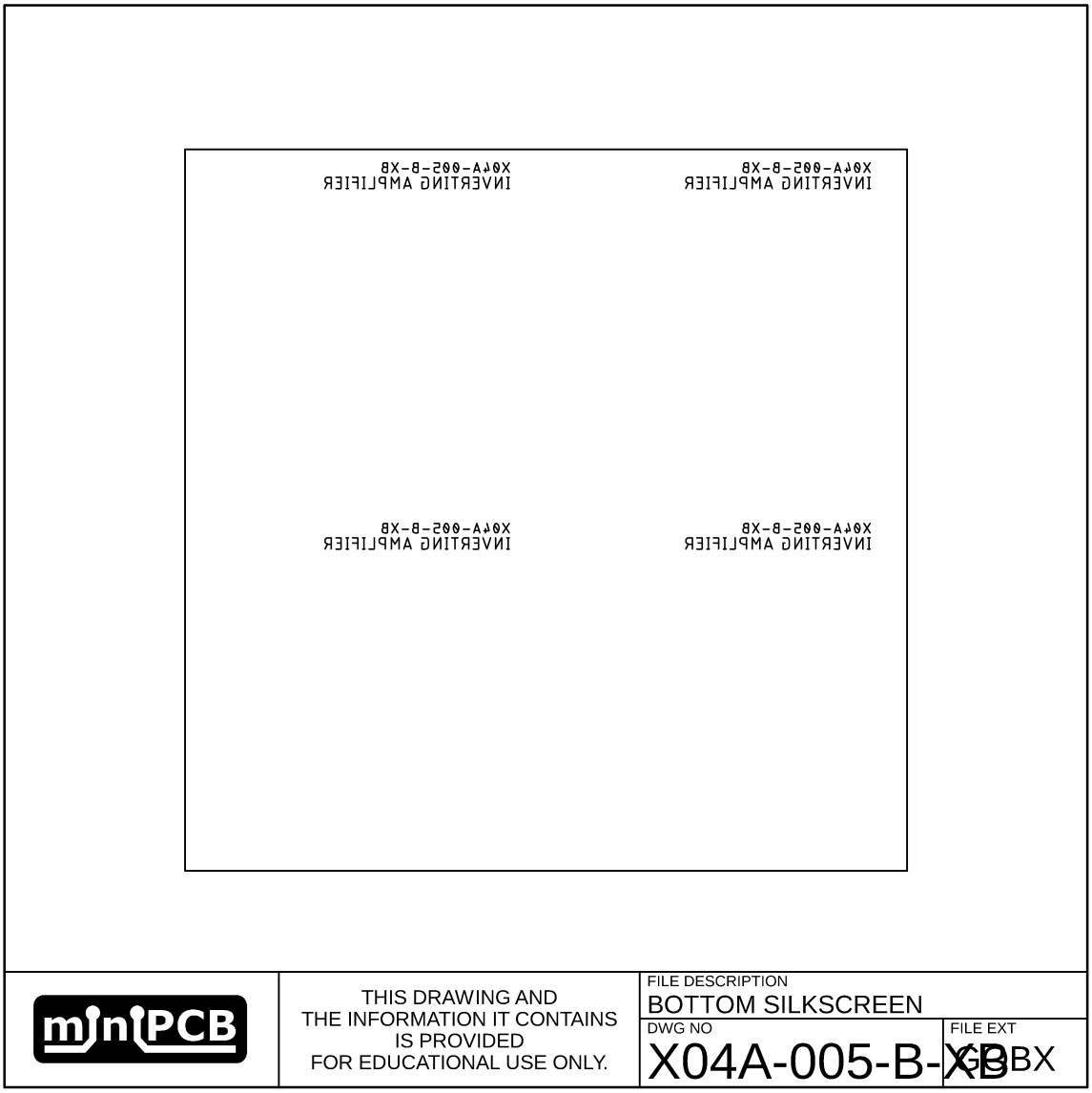
DWG NO: X04A-005-B-XB

FILE EXT: GOTX

BOTTOM SILKSCREEN (GOBX)



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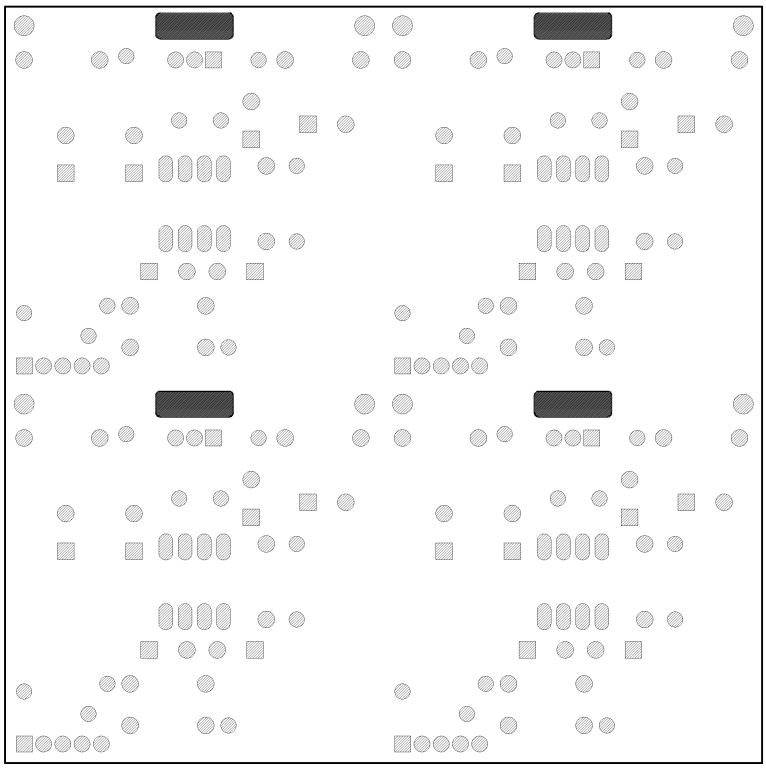

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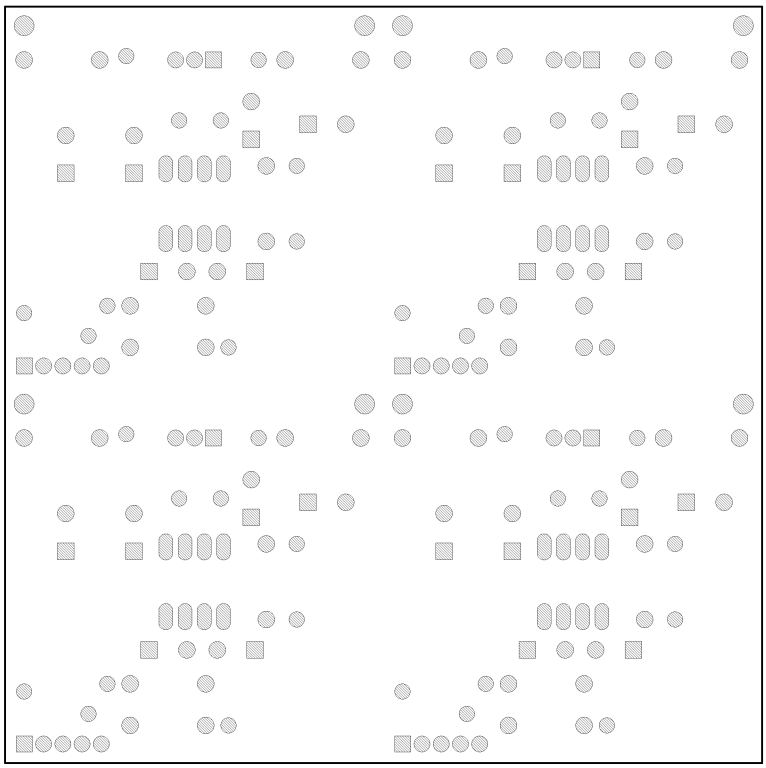
BOTTOM SOLDER MASK (GSBX)



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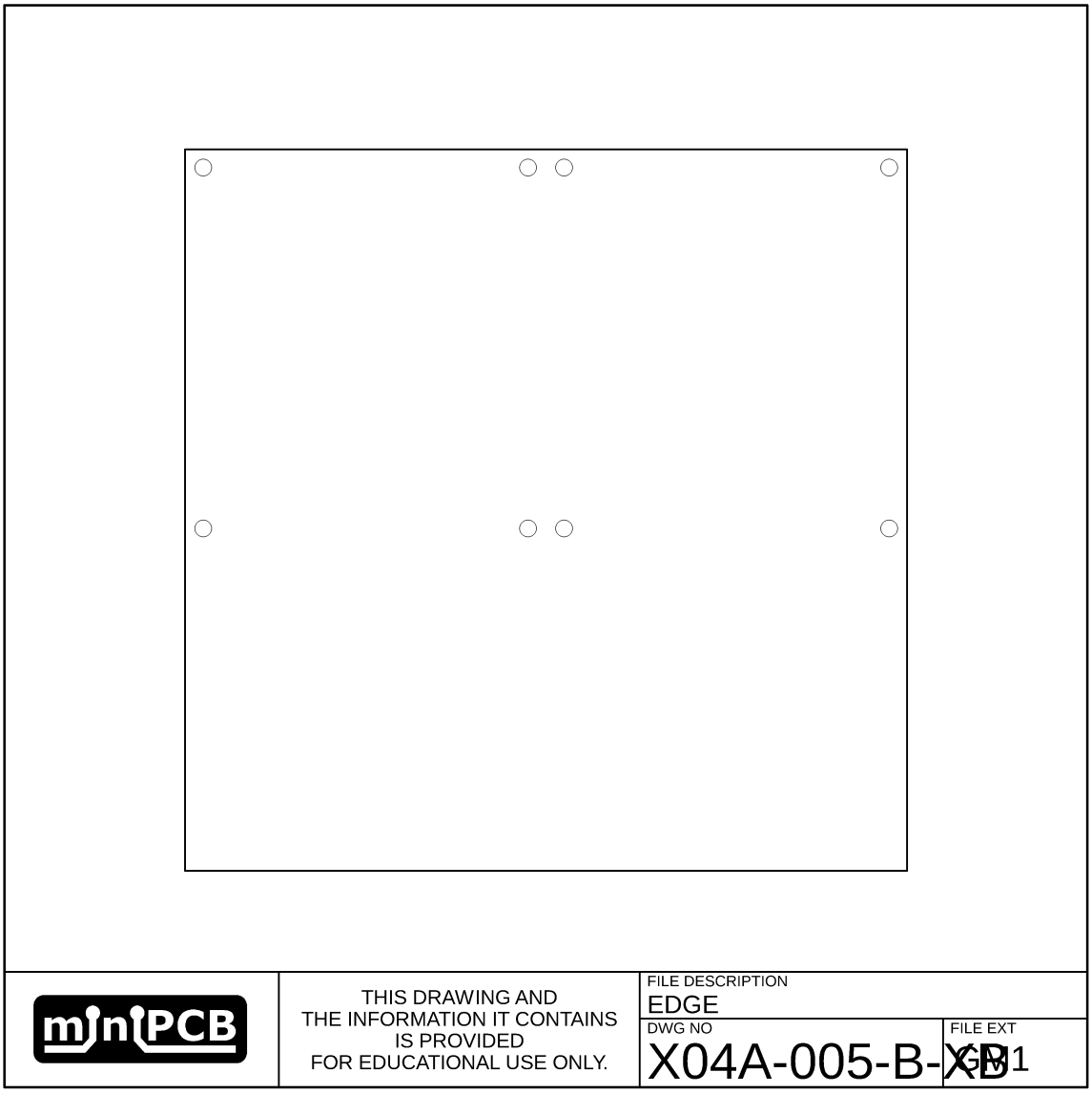
EDGE (GM1)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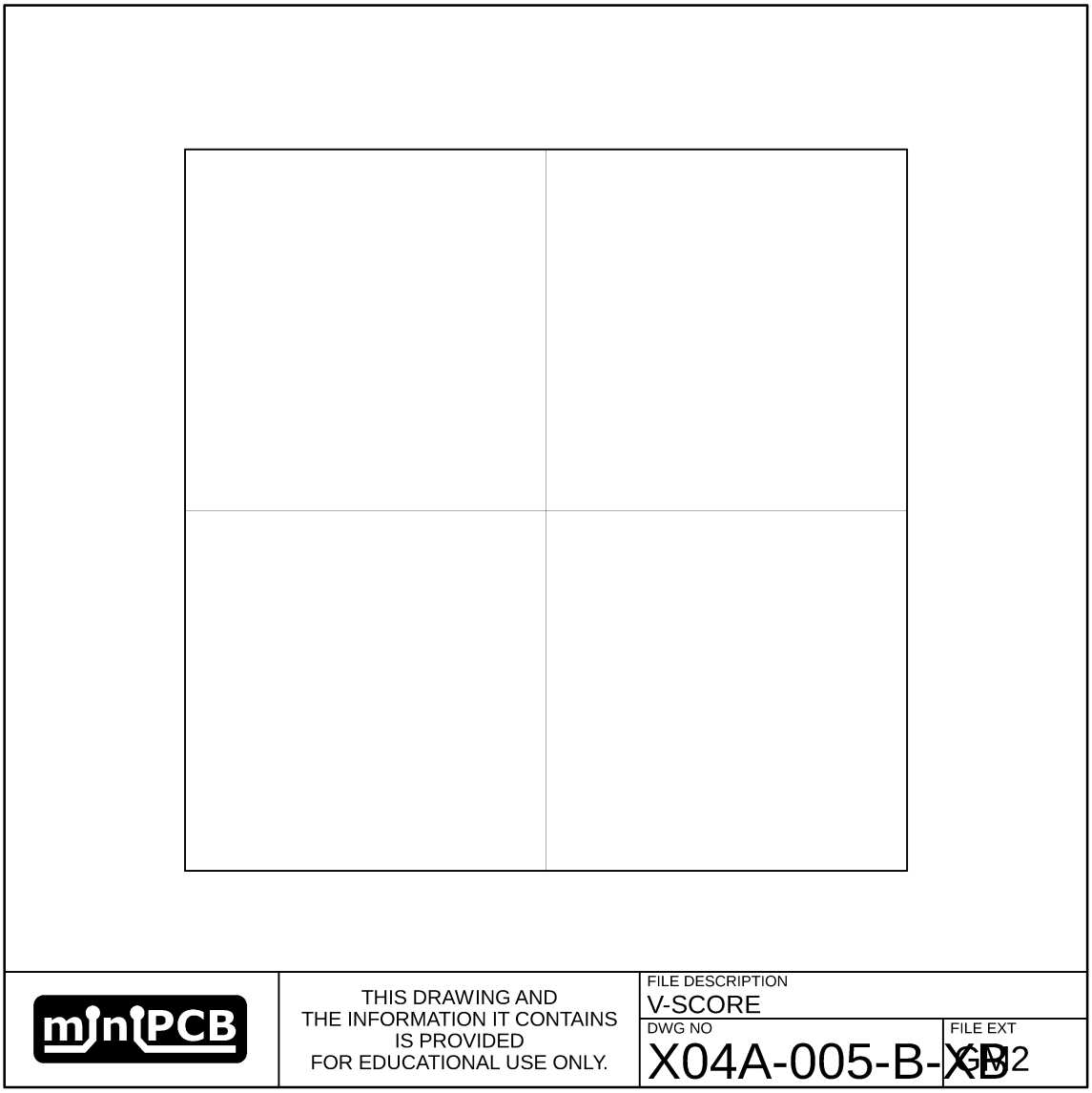
VSCORE (GM2)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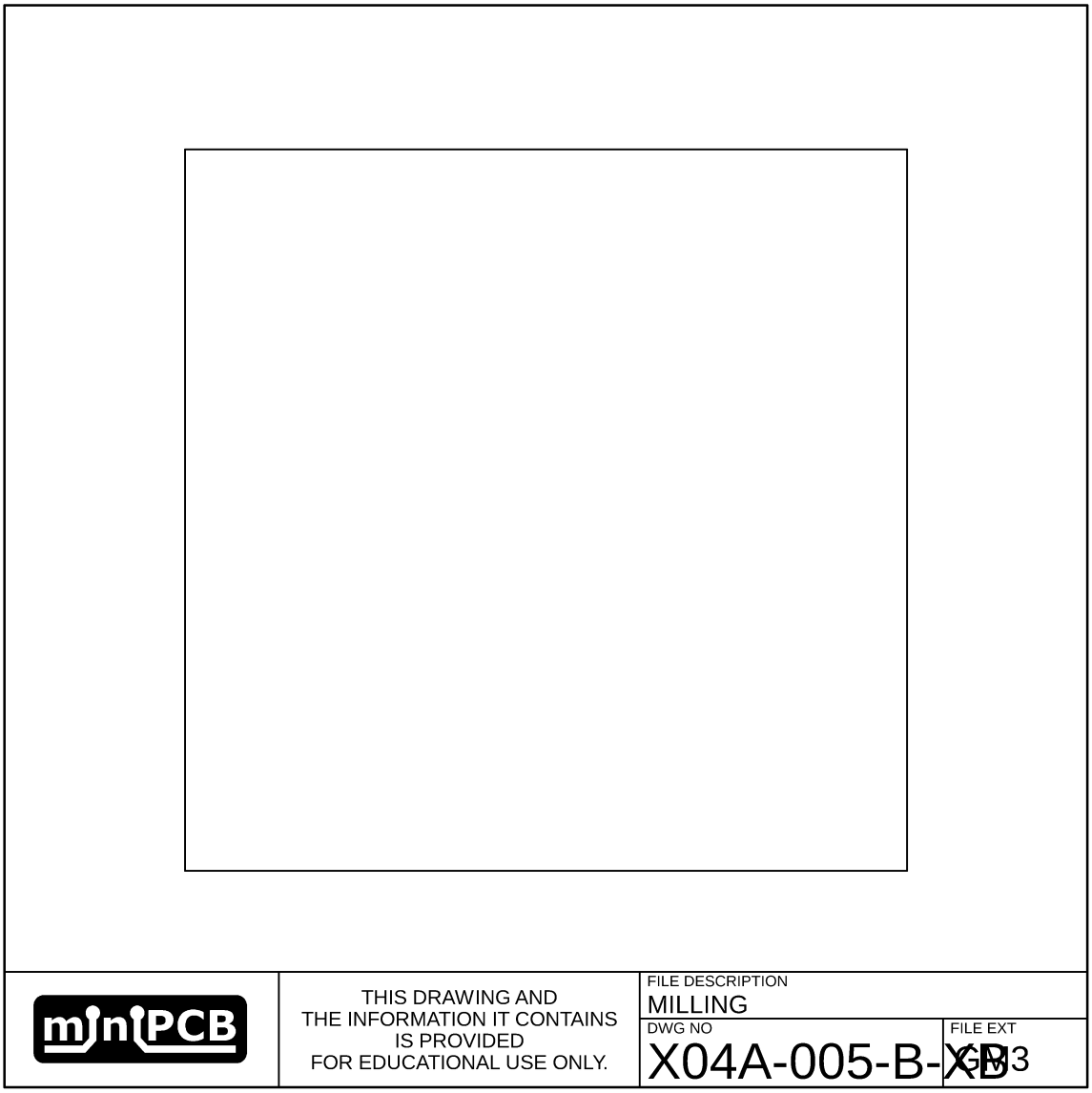
MILLING (GM3)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FILE EXT
GM3

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WORDMARK	FIGUREMARK	FIGUREMARK
miniPCB™		

Revision History

REV	DESCRIPTION	ECO	DATE
A	Initial Release	1002	

Related Content

I want to take “opensource” to the next level by recording the engineering work and posting it to YouTube.

I feel like in 10 years CAD will be a thing of the past and AI Enabled CAD will be the only way to be competitive.

#	TYPE	DESCRIPTION	LOCATION
1	Sale Posting	eBay	
2	Sale Posting	Mouser	
3	Repository	Engineering Files	https://github.com/miniPCB/EAGLE/tree/main/miniPCB/04/A/04A-005
4	Repository	Datasheet	
5	Video	Development	
6	Video	Development	
7	Video	Testing	
8	Video	Engineering Release	