Crystal CS4329 DAC

(20 bit, Bitstream)

December 11, 1997

Parts Suppliers:

Digi-Key Corporation
701 Brooks Ave. South
Thief River Falls, MN 56701

Voice: (800) DIGIKEY
Voice: (218) 681-6674
Fax: (218) 681-3380
http://www.digikey.com

Crystal Semiconductor
PO Box 17847
4210 S. Industrial Dr.
Austin TX 78744

Voice: (800) 888-5016
Voice: (512) 445-7222
Fax: (512) 445-7581
http://www.crystal.com

NOTES:

- The CS8414 receiver chip can be substituted for the CS8412, the CS4390 DAC chip can be substituted for the CS4329. This will add 24 bit / 96 KHz capability to the DAC

- There are four jumpers etched into the circuit board. If you make this circuit board, it will not have plated through holes, so the pads on either end of the jumpers must be connected from the signal side to the ground plane side of the board by soldering a small section of resistor lead on both sides in each of the 8 holes.

- S2 (Switch 2) is absolute phase inversion implemented in the digital domain. The switch is closed for normal phase, open for reversed phase.

- All parts except the crystal chips can be ordered from Digikey, the Digikey part numbers are listed in the parts list. Crystal Semiconductor has distributors worldwide, call or write to Crystal Semiconductor to find the location of the distributor nearest you.

BOARD ETCHING TECHNIQUE:

The artwork is printed onto transparency film from a laser printer, print it three times. Cut out two of the prints with about a quarter inch of clear space around the circuit board image. Then carefully tape these two copies to the uncut one after carefully aligning the traces of the overlay to the uncut sheet's traces. When finished, there should be three perfectly stacked copies. This increases the contrast of the final image. When a transparency is printed with a laser printer, there are usually holes in the black printed parts. And the blacks aren't all that black when it is held up to the light. Overlaying makes the blacks much more black, and gets rid of the holes. Now the artwork is ready to use.

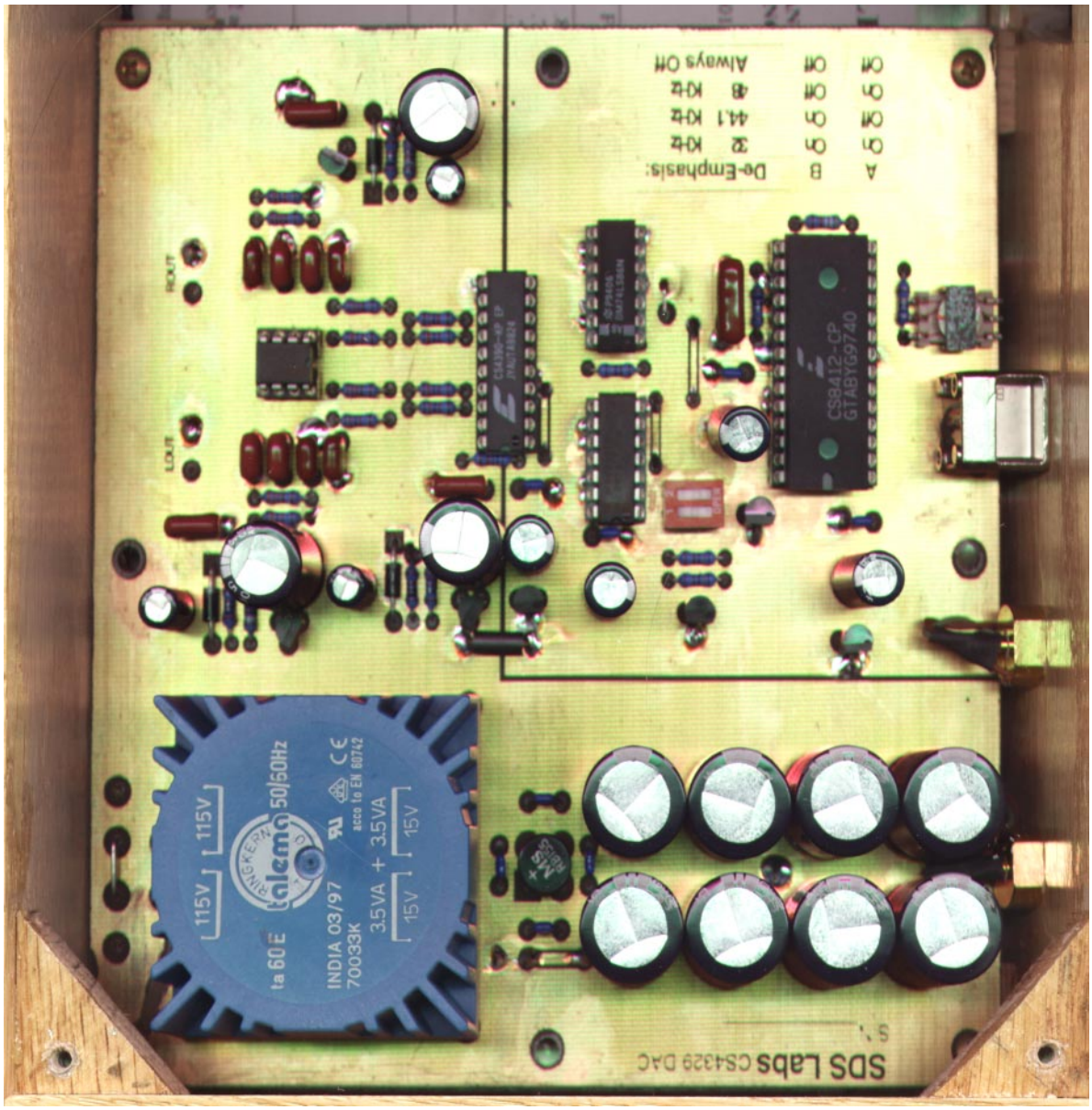
This method uses GC® positive sensitized boards and developer. The FR-4 fiberglass 1 Oz. grade board works very well (they can be gotten local electronics stores). The board emulsion is sensitive to UV light, A good source of UV to expose the board is a GE® sunlamp. The sunlamp is hung so the bottom of the bulb is about 12" above the board. The exposure time is 9 minutes. With a yellow incandescent bug light-bulb on, pull the protective coating off the board and carefully align the artwork on top of the board. Then cover the artwork with a piece of glass to hold the artwork against the board (just like making a contact print in photography). Then turn the sun lamp on for 9 min. If a sunlamp is unavailable, the sun at noontime (on a clear day) can be used exposing the board for about 20 minutes.

The exposed board gets dumped into the developer which has been mixed up beforehand. The developer says to use a 1:9 concentration of developer to water, but a 1:5 mix can be used, which works faster and can yield slightly better results. However the timing is more tricky, so it is not recommended for the first time. Submerge the board into the developer (A photography developer tray works very well), and rock the solution back and forth over the board. The exposed parts with start to dissolve. The emulsion is green and it will wash away exposing the copper underneath. This is the tricky part. The board must be removed when all the emulsion is off the exposed areas. If the board is removed too soon, the emulsion won't be completely dissolved off the exposed areas and it won't etch, if the board is in the developer too long all the emulsion dissolves and all that is left is a bare board. With the 1:9 solution this time window is about a minute, with a 1:5 solution it's about 20 seconds. The board is removed from the developer and washed off with room temperature water, then scrape at a an exposed area and see of there is any emulsion left there. if there is, place the board back in the developer for a few seconds. Repeat this as necessary until the exposed areas clear. With a little practice, it's pretty obvious when it's time to pull the board out. Do all the developing using the yellow bug light. When the board is done, wash it off and let it dry. Be careful of the emulsion, it's easily scratched, especially when fresh from the developer.

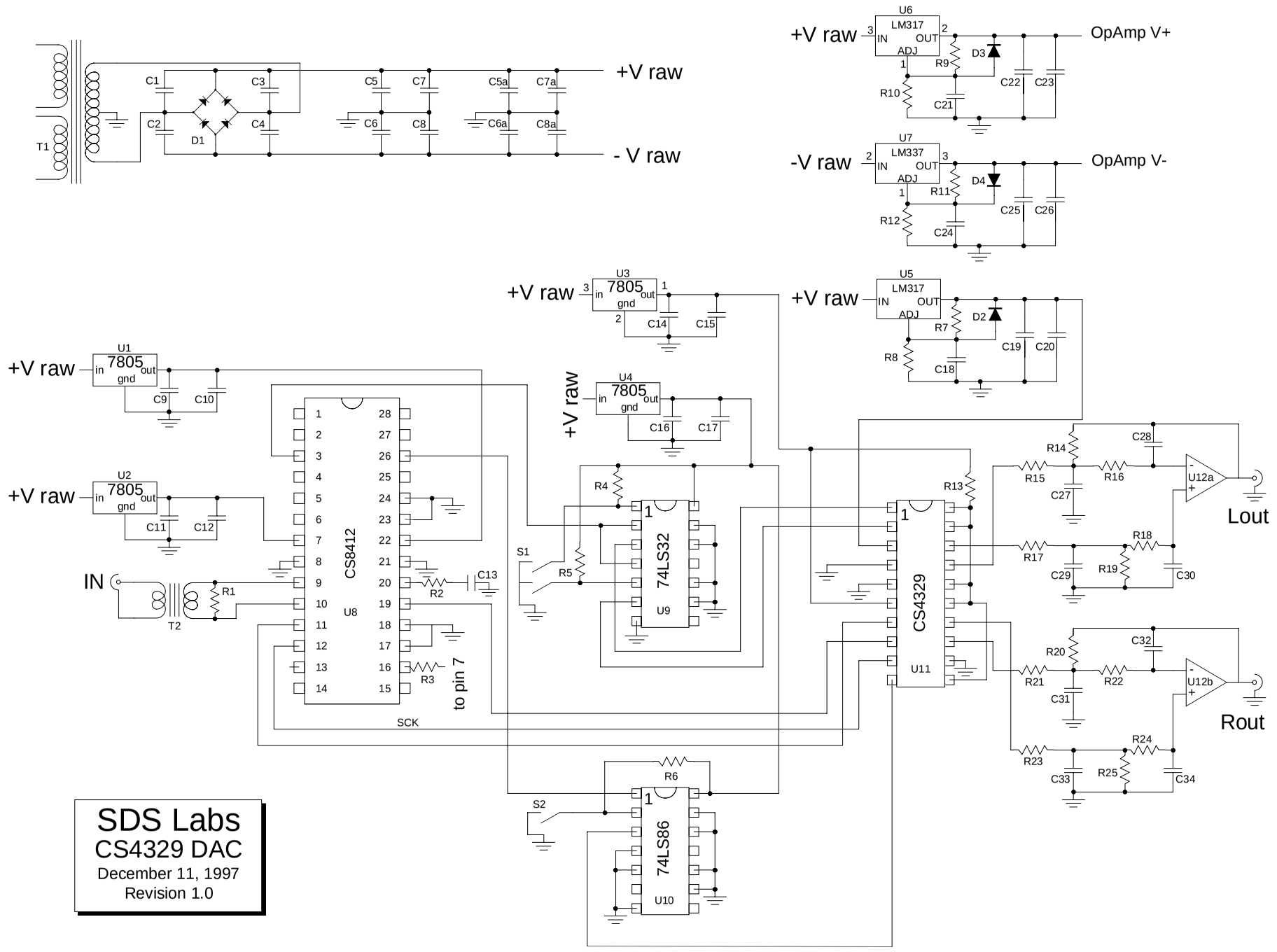
Next, drop the board into an etching solution. Ferric Chloride is available from the same electronic outlets where the GC® boards and developer are purchased or from Radio Shack®. Ferric Chloride is a nasty smelling, iodine looking, serious staining stuff. Pour out the developer from the tray, wash it out and add the etchant. Then put the board into the etchant and rock gently back and forth for about a half hour or so, until all the exposed areas are clear. Then remove the board and wash it clean. The emulsion can then be removed with acetone or alcohol.

Then all the holes need to be drilled in the board. A Dremel® moto tool works well for drilling the small holes, a small drill press would also work.

COMPLETED CS4329 DAC PROTOTYPE:



SCHEMATIC:



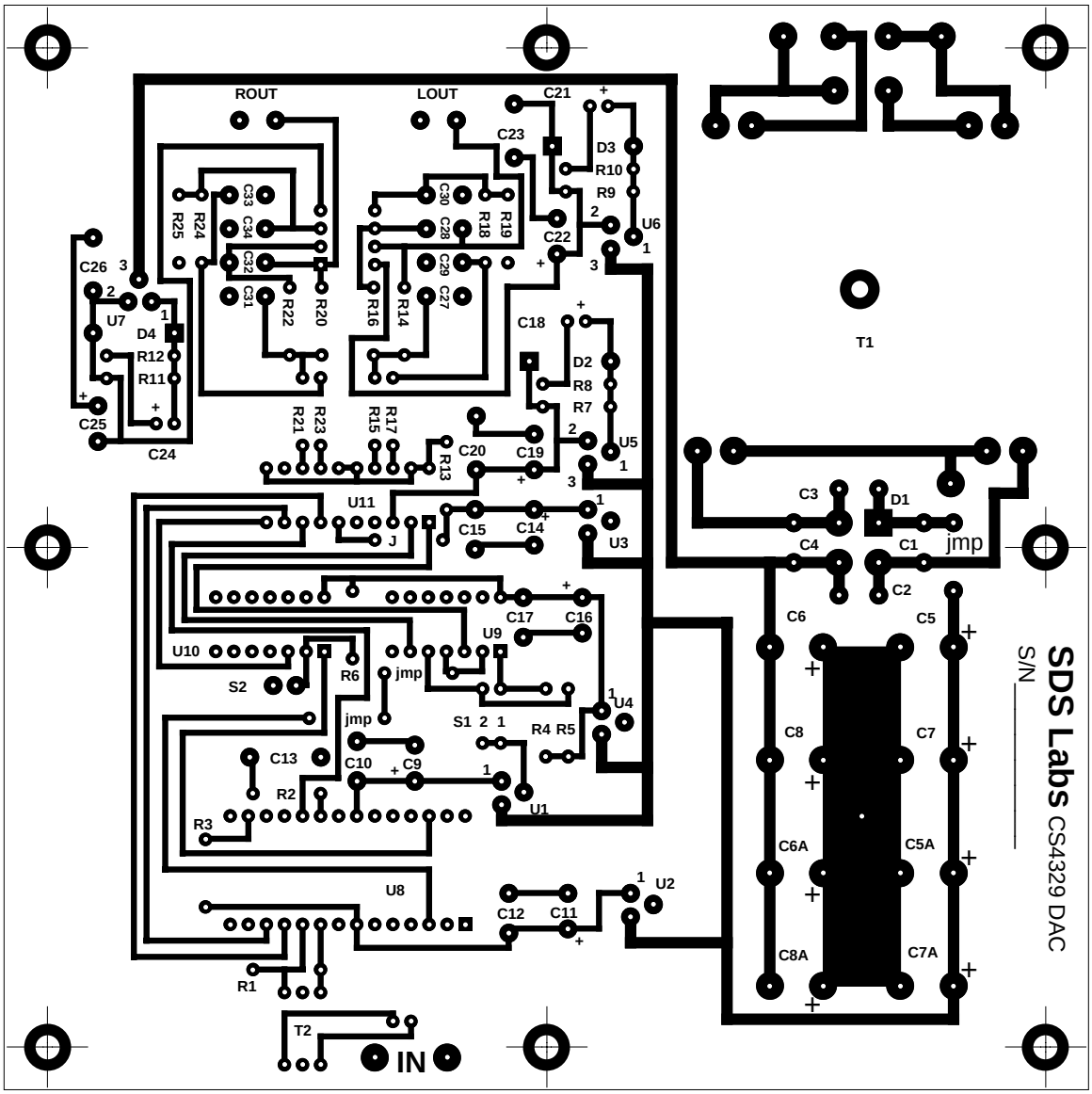
SDS Labs

CS4329 DAC

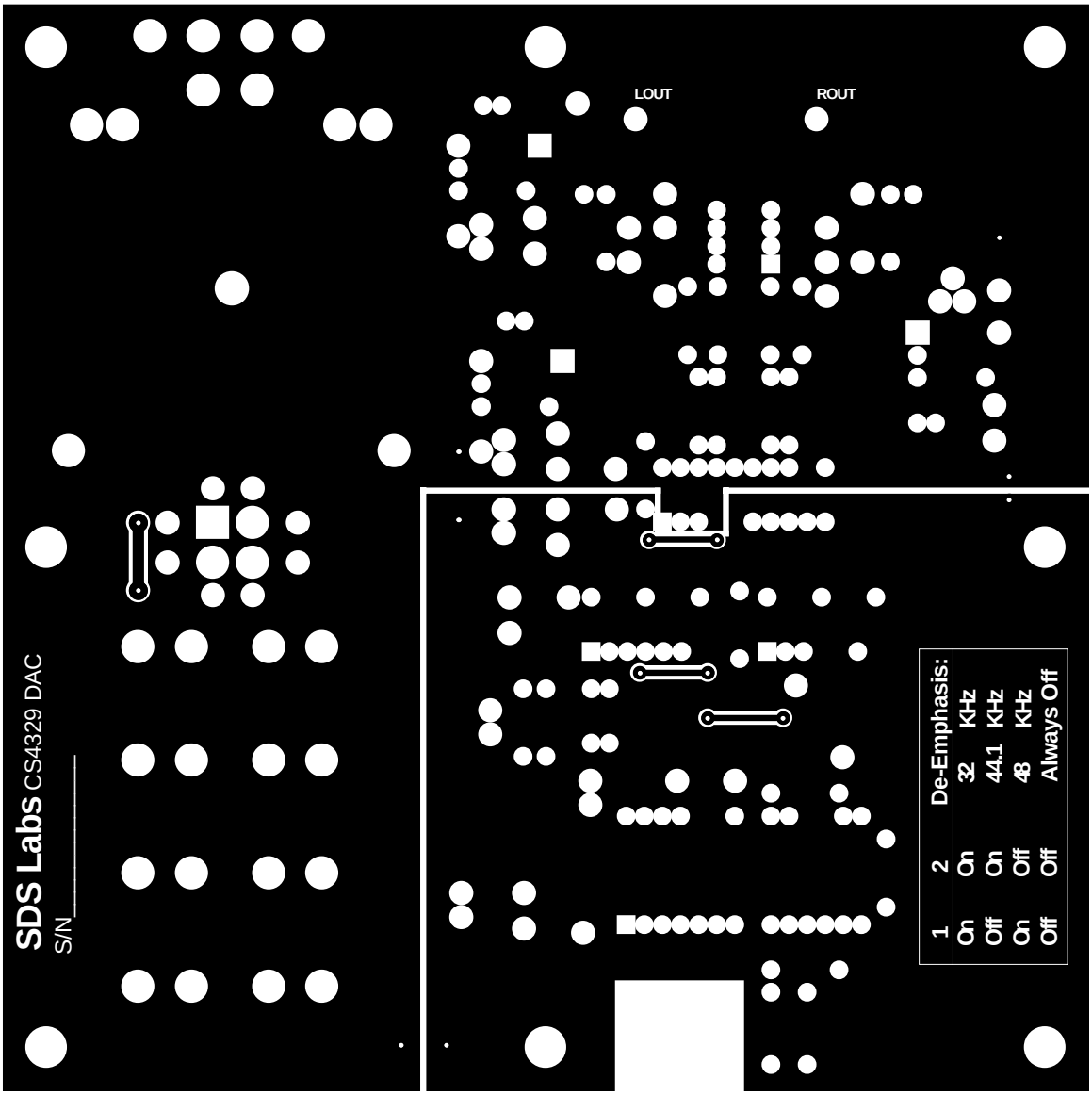
December 11, 1997

Revision 1.0

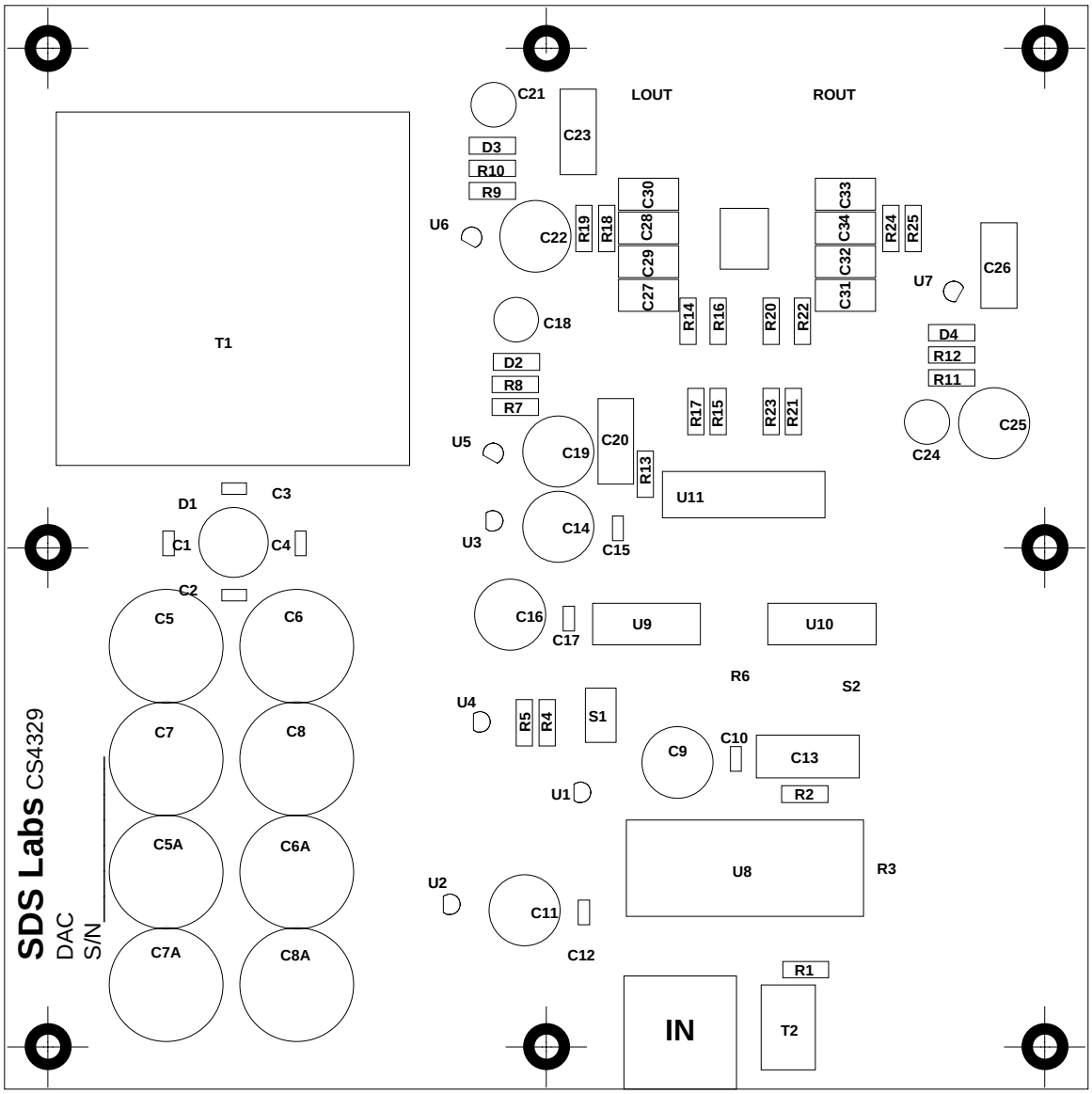
SIGNAL SIDE:


ROUT
LOUT
C21
C23
D3
R10
R9
U6
C22
C26
U7
D4
R12
R11
C25
C24
C18
D2
R8
R7
U5
C20
C19
U11
J
C15
C14
U3
C17
C16
U9
U10
S2
R6
jmp
U4
S1
R4
R5
C13
C10
C9
R2
U1
R3
U8
C12
C11
U2
R1
T2
IN
T1
C3
D1
C4
C1
jmp
C2
C6
C5
C8
C7
C6A
C5A
C8A
C7A
SDS Labs CS4329 DAC
S/N

GROUND (COMPONENT) SIDE:



COMPONENT OUTLINES:



PARTS LIST:

Part #	Description	Manufacturer	Digikey Number	Cost
C1	680 pF 100V Ceramic Cap	Panasonic	P4952-ND	$0.16
C2	680 pF 100V Ceramic Cap	Panasonic	P4952-ND	$0.16
C3	680 pF 100V Ceramic Cap	Panasonic	P4952-ND	$0.16
C4	680 pF 100V Ceramic Cap	Panasonic	P4952-ND	$0.16
C5	1500 uF 25V Cap	Panasonic	P5713-ND	$1.37
C6	1500 uF 25V Cap	Panasonic	P5713-ND	$1.37
C7	1500 uF 25V Cap	Panasonic	P5713-ND	$1.37
C8	1500 uF 25V Cap	Panasonic	P5713-ND	$1.37
C9	470 uF 25V Cap	Panasonic	P5704-ND	$0.70
C10	680 pF 100V Ceramic Cap	Panasonic	P4952-ND	$0.16
C11	470 uF 25V Cap	Panasonic	P5704-ND	$0.70
C12	680 pF 100V Ceramic Cap	Panasonic	P4952-ND	$0.16
C13	0.047 uF 50V Film Cap	Panasonic	P3473-ND	$0.68
C14	470 uF 25V Cap	Panasonic	P5704-ND	$0.70
C15	680 pF 100V Ceramic Cap	Panasonic	P4952-ND	$0.16
C16	470 uF 25V Cap	Panasonic	P5704-ND	$0.70
C17	680 pF 100V Ceramic Cap	Panasonic	P4952-ND	$0.16
C18	120 uF 25V Cap	Panasonic	P5698-ND	$0.32
C19	470 uF 25V Cap	Panasonic	P5704-ND	$0.70
C20	0.01 uF 50V Film Cap	Panasonic	P3103-ND	$0.52
C21	120 uF 25V Cap	Panasonic	P5698-ND	$0.32
C22	470 uF 25V Cap	Panasonic	P5704-ND	$0.70
C23	0.01 uF 50V Film Cap	Panasonic	P3103-ND	$0.52
C24	120 uF 25V Cap	Panasonic	P5698-ND	$0.32
C25	470 uF 25V Cap	Panasonic	P5704-ND	$0.70
C26	0.01 uF 50V Film Cap	Panasonic	P3103-ND	$0.52
C27	0.001 uF 50V Film Cap	Panasonic	P3102-ND	$0.52
C28	0.00022 uF 50V Film Cap	Panasonic	P3221-ND	$0.25
C29	0.001 uF 50V Film Cap	Panasonic	P3102-ND	$0.52
C30	0.00022 uF 50V Film Cap	Panasonic	P3221-ND	$0.25
C31	0.001 uF 50V Film Cap	Panasonic	P3102-ND	$0.52
C32	0.00022 uF 50V Film Cap	Panasonic	P3221-ND	$0.25
C33	0.001 uF 50V Film Cap	Panasonic	P3102-ND	$0.52
C34	0.00022 uF 50V Film Cap	Panasonic	P3221-ND	$0.25
D1	Diode Bridge (1000 PIV)	General Semi.	RB155-ND	$0.74
D2	1A Diode	General Semi.	1N4007GICT-ND	$0.07
D3	1A Diode	General Semi.	1N4007GICT-ND	$0.07
D4	1A Diode	General Semi.	1N4007GICT-ND	$0.07
R1	75 Ω 1/4 Watt Resistor	Yageo	75.0XBK-ND	$0.06
R2	1.00 KΩ 1/4 Watt Resistor	Yageo	1.00KXBK-ND	$0.06
R3	10 KΩ 1/4 Watt Resistor	Yageo	10.0KXBK-ND	$0.06
R4	10 KΩ 1/4 Watt Resistor	Yageo	10.0KXBK-ND	$0.06
R5	10 KΩ 1/4 Watt Resistor	Yageo	10.0KXBK-ND	$0.06
R6	10 KΩ 1/4 Watt Resistor	Yageo	10.0KXBK-ND	$0.06
R7	332 Ω 1/4 Watt Resistor	Yageo	332XBK-ND	$0.06
R8	1 KΩ 1/4 Watt Resistor	Yageo	1.00KXBK-ND	$0.06
R9	191 Ω 1/4 Watt Resistor	Yageo	191XBK-ND	$0.06
R10	2 KΩ 1/4 Watt Resistor	Yageo	2.00KXBK-ND	$0.06
R11	191 Ω 1/4 Watt Resistor	Yageo	191XBK-ND	$0.06
R12	2 KΩ 1/4 Watt Resistor	Yageo	2.00KXBK-ND	$0.06
R13	10 KΩ 1/4 Watt Resistor	Yageo	10.0KXBK-ND	$0.06
R14	13.7 KΩ 1/4 Watt Resistor	Yageo	13.7KXBK-ND	$0.06
R15	13.7 KΩ 1/4 Watt Resistor	Yageo	13.7KXBK-ND	$0.06
R16	3.32 KΩ 1/4 Watt Resistor	Yageo	3.32KXBK-ND	$0.06
R17	13.7 KΩ 1/4 Watt Resistor	Yageo	13.7KXBK-ND	$0.06
R18	3.32 KΩ 1/4 Watt Resistor	Yageo	3.32KXBK-ND	$0.06
R19	13.7 KΩ 1/4 Watt Resistor	Yageo	13.7KXBK-ND	$0.06
R20	13.7 KΩ 1/4 Watt Resistor	Yageo	13.7KXBK-ND	$0.06
R21	13.7 KΩ 1/4 Watt Resistor	Yageo	13.7KXBK-ND	$0.06
R22	3.32 KΩ 1/4 Watt Resistor	Yageo	3.32KXBK-ND	$0.06
R23	13.7 KΩ 1/4 Watt Resistor	Yageo	13.7KXBK-ND	$0.06
R24	3.32 KΩ 1/4 Watt Resistor	Yageo	3.32KXBK-ND	$0.06
R25	13.7 KΩ 1/4 Watt Resistor	Yageo	13.7KXBK-ND	$0.06
S1	2 Position DIP Switch	C&K	CKN3001-ND	$1.35
T1	30Vct 7VA transformer	Telema	TE70033-ND	$12.87
T2	Pulse Transofrmer	Schott	257-1025-ND	$8.15
U1	5V Regulator	JRC	NJM78L05A-ND	$0.42
U2	5V Regulator	JRC	NJM78L05A-ND	$0.42
U3	5V Regulator	JRC	NJM78L05A-ND	$0.42
U4	5V Regulator	JRC	NJM78L05A-ND	$0.42
U5	Adjustable Positive Regulator	Nat. Semi.	LM317LZ-ND	$0.95
U6	Adjustable Positive Regulator	Nat. Semi.	LM317LZ-ND	$0.95
U7	Adjustable Negative Regulator	Nat. Semi.	LM337LZ-ND	$1.82
U8	Decoder Chip (CS8412-CP)	Crystal		$30.00
	or (CS8414-CP) for 24 bit / 96 KHz			
U9	OR Chip	Fairchild	MM74HC32N-ND	$0.42
U10	XOR Chip	Fairchild	MM74HC86N-ND	$0.53
U11	DAC Chip (CS4329-KP)	Crystal		$40.00
	or (CS4390-KP) for 24 bit / 96 KHz			
U12	OP-Amp	Burr Brown	OPA-2132P-ND	$6.91
			Total:	$126.02