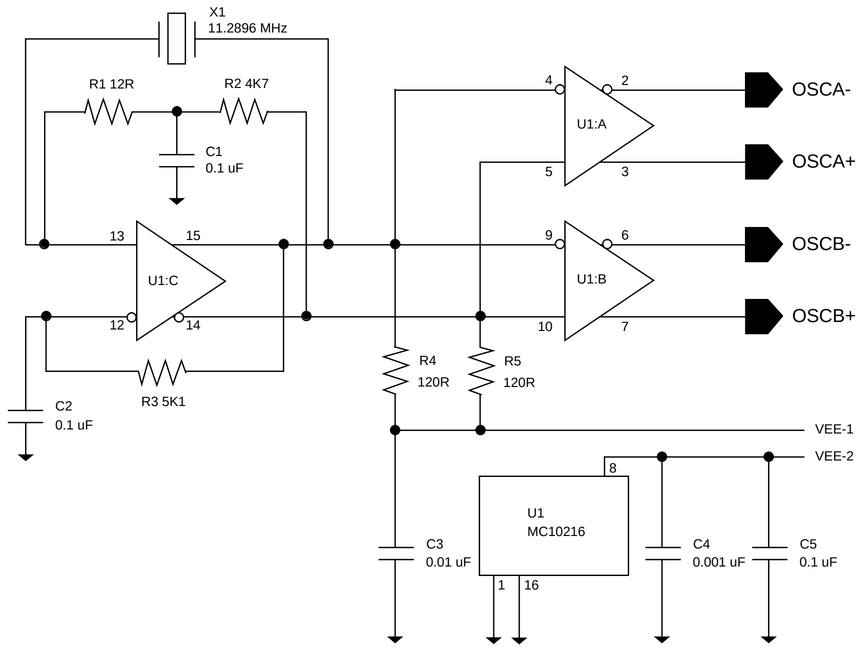
Digital Output One V1.1

by
Erland Unruh

erland.unruh@trab.se

Crystal Oscillator

This crystal oscillator circuitry is lifted directly from Winser[1] with the only addition of one extra buffer. Winser on his part has lifted the oscillator circuitry from Matthys[2] with component values adjusted for 11 MHz. The major part of the circuitry is also available in the IQD Crystal Product Data Book[3] application notes.

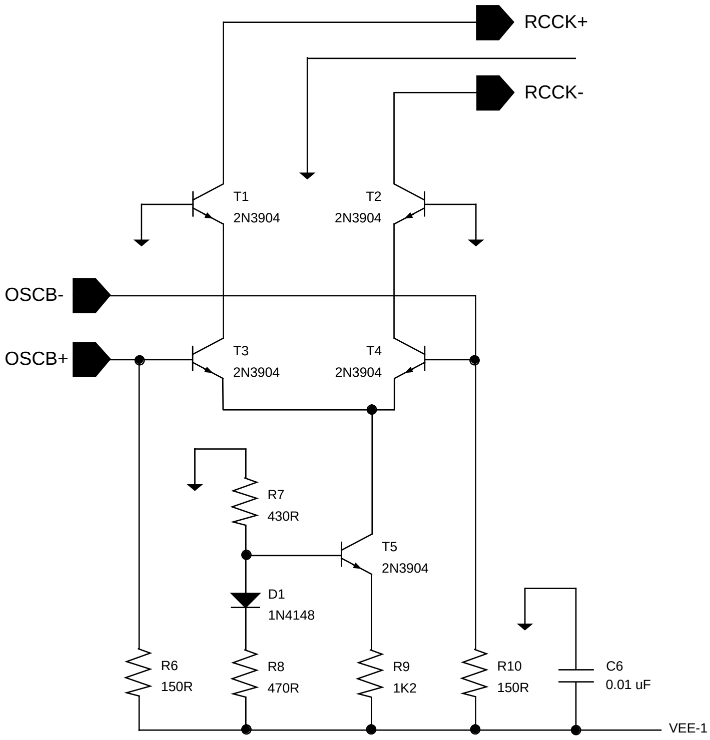


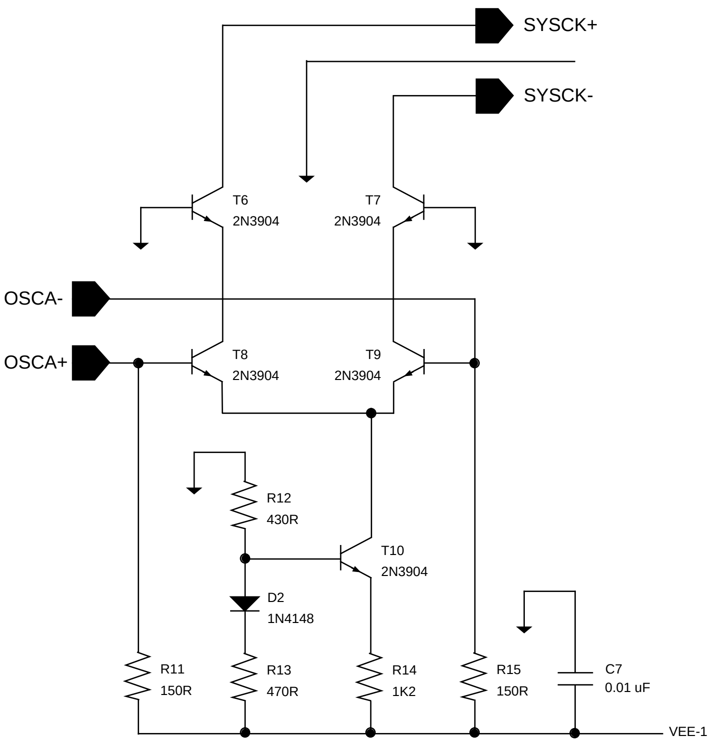
R1 should match the equivalent series resistance of the crystal. So for e.g. a 16 MHz crystal R1 should be changed from 12R to 10R.

This oscillator expects a crystal specified for series resonance. Most Philips players seems to be using crystals specified for parallel resonance. The only difference between these two kinds of crystals is that they are cut for slightly different frequencies to match the usage. Thus, a parallel crystal used where a series one is expected will result in a slightly lower frequency than expected. It's not a large difference (about 300ppm), but it's probably enough to make a DAC with an advanced PLL to not lock.

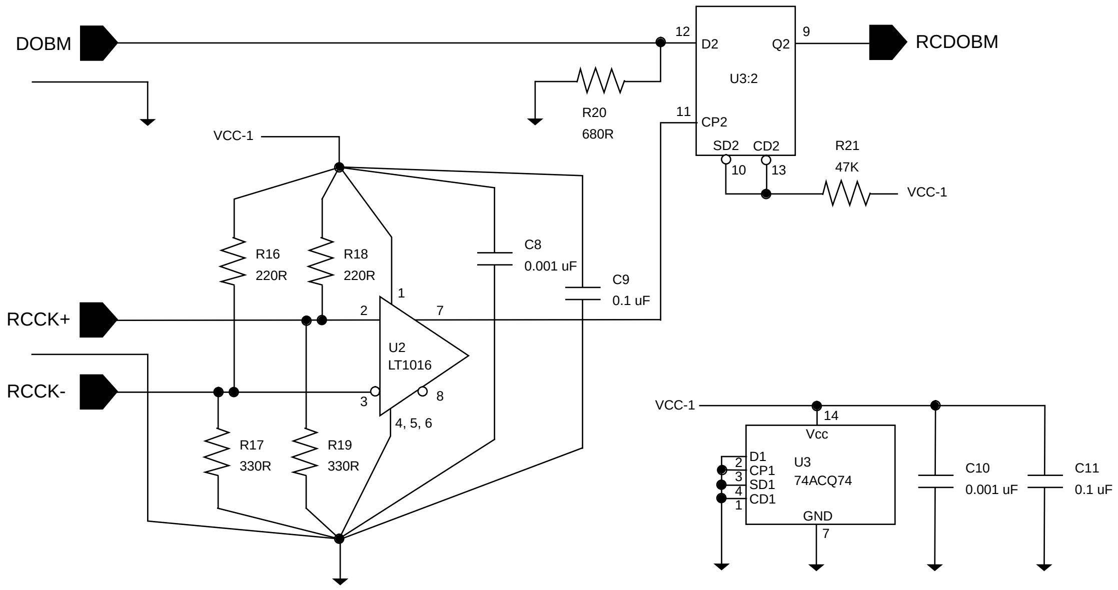
The crystal is a piezoelectric device, so its electrical performance is effected by physical vibration. Best to mount it on a lump of Sorbothane. Also glue a damping mass of metal to it and connect it with thin leads in angles so they don't interfere with the crystal being able to move.

Clock Interface





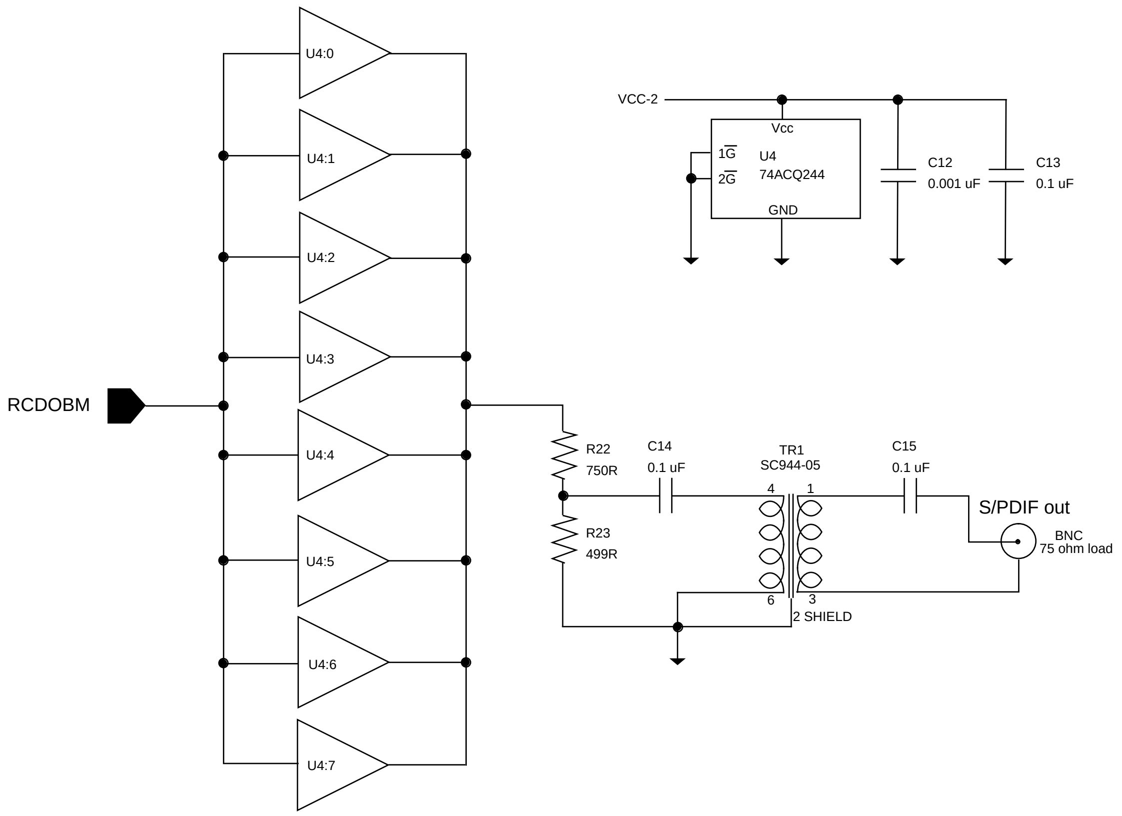
Re-Clocker



To insure good operation of the reclocker, make sure that the data on D2 is stable 10 ns on both sides of the rising clock edge on CP2. If it isn’t stable, invert the SYSCK as described later.

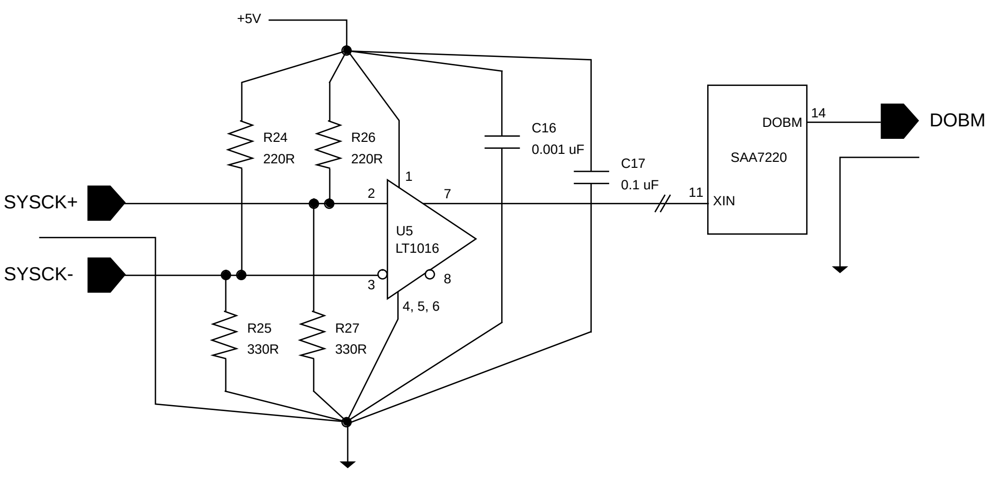
The DOBM signal should be reclocked at 5.6448 MHz. For a normal Philips chip set CD player the system clock is 11.2896 MHz. That is also the value of RCCK. For not using more components than necessary (and perhaps introduce more jitter), the reclocker uses the system clock for reclocking without dividing it by 2 to achieve the required 5.6448 MHz. This doesn’t affect the operation of the reclocker, it only decreases the width of the time window in which the DOBM data must be stable. This solution also makes the reclocker more flexible in relation to other system clock frequencies. It will work as long as the system clock is n times the data rate (n >= 1). In the CD case (44.1KHz sampling frequency) the system clock can be any of 5.6448 MHz, 11.2896 MHz, 16.9344 MHz and so on.

Coax Driver



Note: Impedance matching is based on that the HF-transformer is of type 2:1. So if for some reason a 1:1 transformer is used as a replacement, the resistor values have to be recalculated.

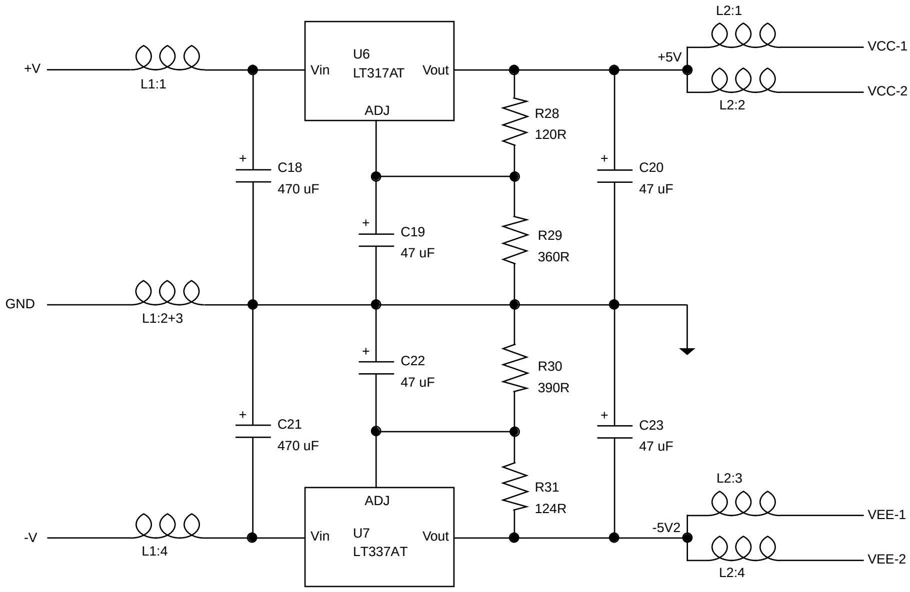
Player Interface



The above interface circuitry should be mounted close to the XIN on the SAA7220. The crystal oscillator in the player must also be disabled. This is often a 11.2896 MHz crystal, a resistor and two capacitors around pin 10 and 11 on the SAA7220. It is also a good idea to disable everything that might be connected to pin 14 on the SAA7220.

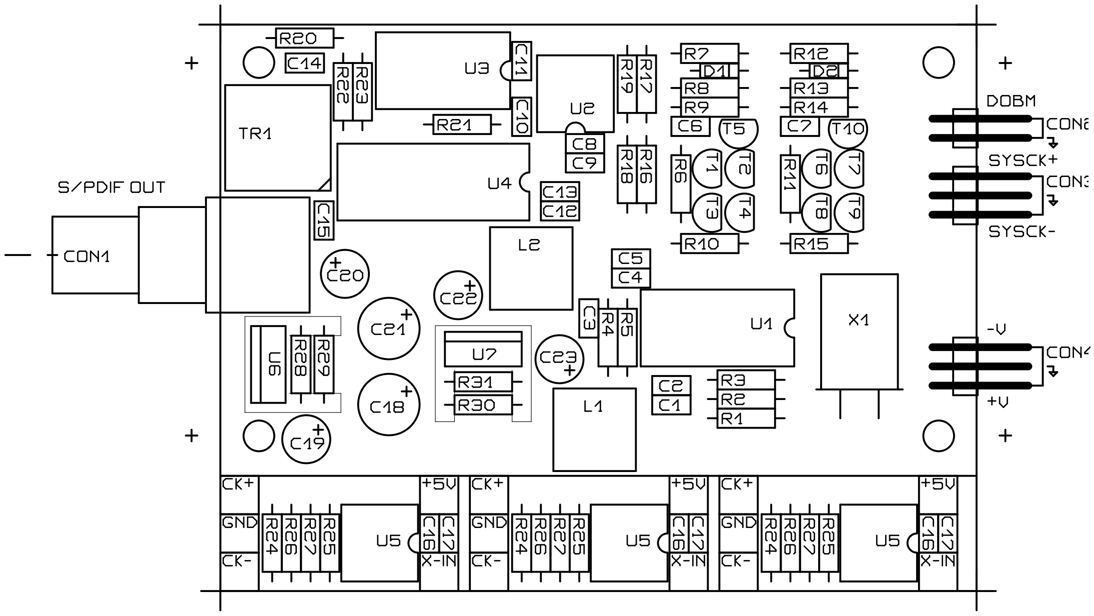
If a 180 degree phase difference is needed between the SYSCK and RCCK clocks, then exchange SYSCK+ and SYSCK- in the CON3 female connector.

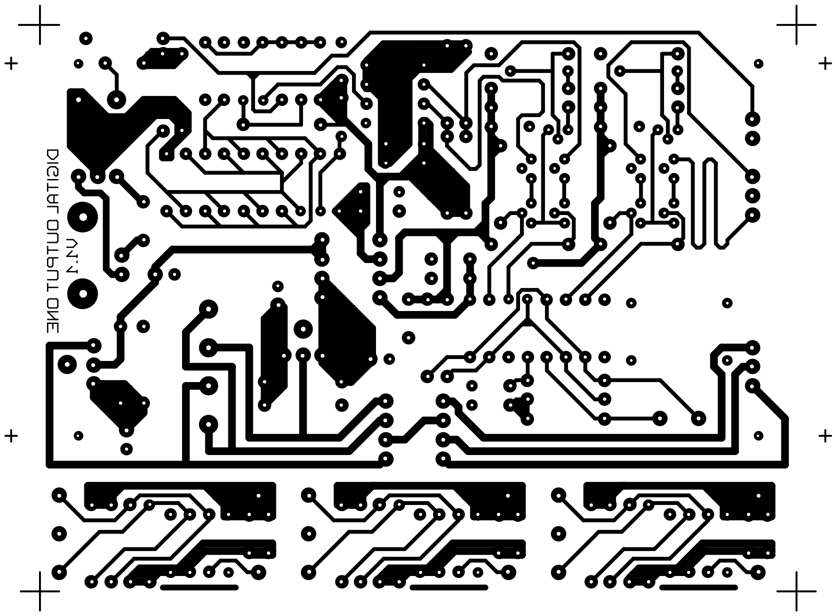
Power Supply

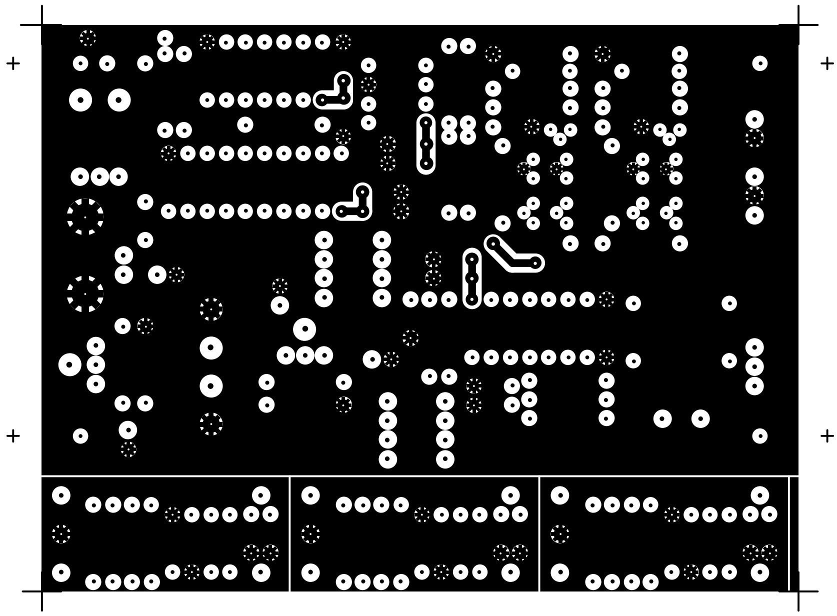


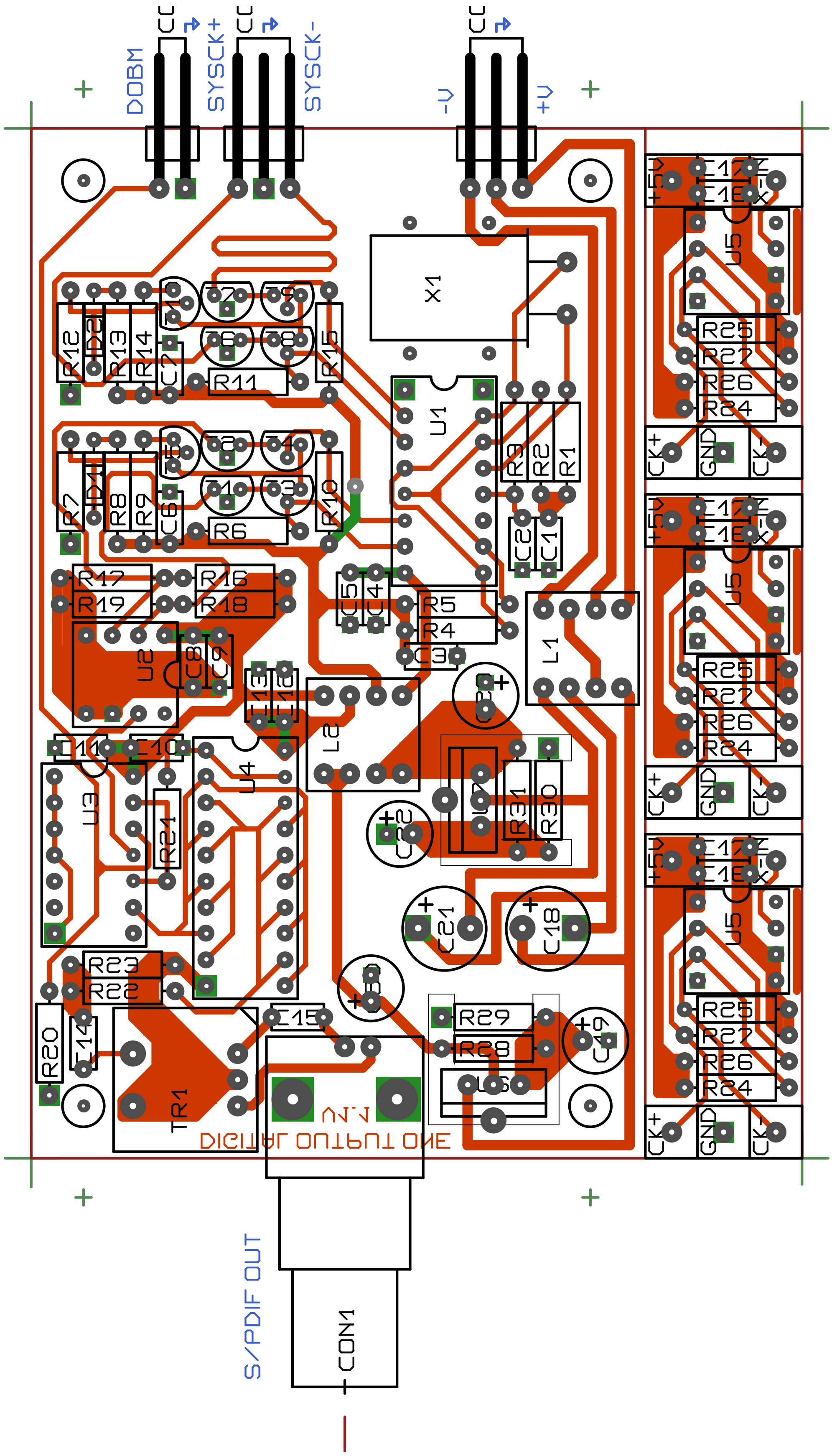
+V and -V can normally be stolen from the players power supply. Most players have unregulated power rails of about +9V or +11V and -9V or -11V. Make sure that the power is taken <u>before</u> any kind of current limiters.

PCB Layouts and silk screen








DOBM
SYSCK+
SYSCK-
-V
+V
S/PDIF OUT
CON1
DIGITAL OUTPUT ONE
V1.1
TR1
U1
U2
U3
U4
X1
L1
L2

Parts List

C. Id	Description	Value	Art.no.	Page	Com.	N	DH
U1	ECL circuit	MC10216			ACG	1	
U2	Comparator	LT1016	73-101-62	881		2	
U3	CMOS circuit	74ACQ74	73-621-22	995	74AC74	1	
U4	CMOS circuit	74ACQ244			ACG	1	
U5	Comparator	LT1016	73-101-62	881			
U6	Regulator, positive	LT317AT	73-317-05	944		1	0,9
U7	Regulator, negative	LT337AT	73-337-01	947		1	0,9
U1’	Heat sink	DIL16					
U4’	IC socket, DIL, series 42000	20 pin	48-159-57	482		1	0,8
U5’	IC socket, DIL, series 17000	8 pin	48-135-49	481		1	0,7
U6’	Heat sink	TO220	75-612-28	1139		2	
U7’	Heat sink	TO220	75-612-28	1139			
X1	Crystal	11.2896MHz			IQD?		
X1’	Sorbothane				HFN/RR		
TR1	HF transformer 2:1	SC944-05			SC	1	0,8
T1	NPN Transistor	2N3904	71-009-44	831		10	0,6
T2	NPN Transistor	2N3904	71-009-44	831			0,6
T3	NPN Transistor	2N3904	71-009-44	831			0,6
T4	NPN Transistor	2N3904	71-009-44	831			0,6
T5	NPN Transistor	2N3904	71-009-44	831			0,6
T6	NPN Transistor	2N3904	71-009-44	831			0,6
T7	NPN Transistor	2N3904	71-009-44	831			0,6
T8	NPN Transistor	2N3904	71-009-44	831			0,6
T9	NPN Transistor	2N3904	71-009-44	831			0,6
T10	NPN Transistor	2N3904	71-009-44	831			0,6
D1	Diode	1N4148	70-005-57	818		2	0,7
D2	Diode	1N4148	70-005-57	818			0,7
R1	MF resistor 1% (1/4W)	12R	60-700-80	716		1	0,7
R2	MF resistor 1% (1/4W)	4K7	60-730-43	718		1	0,7
R3	MF resistor 1% (1/4W)	5K1	60-730-84	718		1	0,7
R4	MF resistor 1% (1/4W)	120R	60-712-29	717		3	0,7
R5	MF resistor 1% (1/4W)	120R	60-712-29	717			0,7
R6	MF resistor 1% (1/4W)	150R	60-713-28	717		4	0,7
R7	MF resistor 1% (1/4W)	430R	60-718-56	717		2	0,7
R8	MF resistor 1% (1/4W)	470R	60-719-06	717		2	0,7
R9	MF resistor 1% (1/4W)	1K2	60-723-67	717		2	0,7
R10	MF resistor 1% (1/4W)	150R	60-713-28	717			0,7
R11	MF resistor 1% (1/4W)	150R	60-713-28	717			0,7
R12	MF resistor 1% (1/4W)	430R	60-718-56	717			0,7
R13	MF resistor 1% (1/4W)	470R	60-719-06	717			0,7
R14	MF resistor 1% (1/4W)	1K2	60-723-67	717			0,7
R15	MF resistor 1% (1/4W)	150R	60-713-28	717			0,7
R16	MF resistor 1% (1/4W)	220R	60-715-00	717		4	0,7
R17	MF resistor 1% (1/4W)	330R	60-717-16	717		4	0,7
R18	MF resistor 1% (1/4W)	220R	60-715-00	717			0,7
R19	MF resistor 1% (1/4W)	330R	60-717-16	717			0,7
R20	MF resistor 1% (1/4W)	680R	60-720-94	717		1	0,7
R21	MF resistor 1% (1/4W)	47K	60-741-81	718		1	0,7
R22	MF resistor 1% (1/4W)	750R	60-721-44	717		1	0,7
R23	MF resistor 1% (1/4W)	499R	60-719-30	717		1	0,7
R24	MF resistor 1% (1/4W)	220R	60-715-00	717			0,7
R25	MF resistor 1% (1/4W)	330R	60-717-16	717			0,7
R26	MF resistor 1% (1/4W)	220R	60-715-00	717			0,7
R27	MF resistor 1% (1/4W)	330R	60-717-16	717			0,7
R28	MF resistor 1% (1/4W)	120R	60-712-29	717			0,7
R29	MF resistor 1% (1/4W)	360R	60-717-65	717		1	0,7
R30	MF resistor 1% (1/4W)	390R	60-718-07	717		1	0,7

C. Id	Description	Value	Art.no.	Page	Com.	N	DH
R31	MF resistor 1% (1/4W)	124R	60-712-45	717		1	0,7
C1	Capacitor, Kemet, Golden Max, X7R	0.1 uF 50V	65-716-81	777		9	0,7
C2	Capacitor, Kemet, Golden Max, X7R	0.1 uF 50V	65-716-81	777			0,7
C3	Capacitor, Kemet, Golden Max, X7R	0.01 uF 50V	65-715-41	777		3	0,7
C4	Capacitor, Kemet, Golden Max, NP0	0.001 uF 200V	65-708-57	777		5	0,7
C5	Capacitor, Kemet, Golden Max, X7R	0.1 uF 50V	65-716-81	777			0,7
C6	Capacitor, Kemet, Golden Max, X7R	0.01 uF 50V	65-715-41	777			0,7
C7	Capacitor, Kemet, Golden Max, X7R	0.01 uF 50V	65-715-41	777			0,7
C8	Capacitor, Kemet, Golden Max, NP0	0.001 uF 200V	65-708-57	777			0,7
C9	Capacitor, Kemet, Golden Max, X7R	0.1 uF 50V	65-716-81	777			0,7
C10	Capacitor, Kemet, Golden Max, NP0	0.001 uF 200V	65-708-57	777			0,7
C11	Capacitor, Kemet, Golden Max, X7R	0.1 uF 50V	65-716-81	777			0,7
C12	Capacitor, Kemet, Golden Max, NP0	0.001 uF 200V	65-708-57	777			0,7
C13	Capacitor, Kemet, Golden Max, X7R	0.1 uF 50V	65-716-81	777			0,7
C14	Capacitor, Kemet, Golden Max, X7R	0.1 uF 50V	65-716-81	777			0,7
C15	Capacitor, Kemet, Golden Max, X7R	0.1 uF 50V	65-716-81	777			0,7
C16	Capacitor, Kemet, Golden Max, NP0	0.001 uF 200V	65-708-57	777			0,7
C17	Capacitor, Kemet, Golden Max, X7R	0.1 uF 50V	65-716-81	777			0,7
C18	Capacitor, ELNA, RSH	470uF 16V	67-190-09	783		2	0,7
C19	Capacitor, OSCON, SA	47 uF 16V	67-200-15	784		4	0,7
C20	Capacitor, OSCON, SA	47 uF 16V	67-200-15	784			0,7
C21	Capacitor, ELNA, RSH	470uF 16V	67-190-09	783			0,7
C22	Capacitor, OSCON, SA	47 uF 16V	67-200-15	784			0,7
C23	Capacitor, OSCON, SA	47 uF 16V	67-200-15	784			0,7
L1	Multibead, Amidon, 43	1-500 MHz	58-736-09	703		2	0,7
L2	Multibead, Amidon, 43	1-500 MHz	58-736-09	703			0,7
CON1	Jack, BNC	75 ohm	46-253-31	463		1	0,8+2,0
CON1’	Nut		46-253-98	463		1	
CON2	Stiftlist med låsning, vinklad	2 pin	43-810-34	408		1	0,9
CON3	Stiftlist med låsning, vinklad	3 pin	43-810-00	408		2	0,9
CON4	Stiftlist med låsning, vinklad	3 pin	43-810-00	408			0,9
CON2’	Kontakthus	2 pin	43-804-65	407		1	
CON3’	Kontakthus	3 pin	43-804-08	407		2	
CON4’	Kontakthus	3 pin	43-804-08	407			
CON”	Connector element	1 pin	43-805-98	407		8	
PCB	Glas fiber, 2 sides, 75*100 mm	1mm, 35u Cu	49-575-77	530		1	

Article numbers and page references refer to the ELFA catalogue no 43, 1995, when available.

DH is the size of the hole to be drilled in mm to fit the components.

Acknowledgments

This project came true because: Paul Winser opened my eyes for this issue with his good jitter articles and further helpful comments, Norman Tracy for helpful comments and providing difficult to get components via Audio Crafters Guild and Robert Macy (AJM Electronics) for very knowledgable help with RFI problems and ECL design. All interaction performed via Internet.

References

[1] CD Jitter - A Solution, Paul Winser, 1994.

[2] Crystal Oscillator Circuits, Robert J. Matthys, John Wiley & Sons, 1983.

[3] Crystal Product Data Book, IQD Limited, 1994.