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# D1001998-v2 (spd3)

## *aLIGO PSL Circuit Board Documentation*

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### Abstract

Inner-loop power stabilization photodiode for the aLIGO PSL.

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## Safety Instructions

In order to operate the circuit properly and safely, review the following guidelines before installing and using the unit. Failure to do so may result in equipment damage or bodily injury:

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This circuit was designed as a laboratory equipment to be operated only by trained and qualified technicians in research institutes or development departments. For safety reasons, usage by other persons or in other environments is *not* recommended.

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- This circuit uses extra-low voltage ( $< 50 V_{AC}$  and  $< 75 V_{DC}$ ) and is therefore exempt from the regulations of the *Low Voltage Directive* (2006/95/EC).
  - The unit does not contain any mechanical drive system. Therefore, the regulations of the *Machinery Directive* (2006/42/EC) do not apply.
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## Sicherheitshinweise

Nehmen Sie vor Aufbau und Inbetriebnahme des Geräts folgende Empfehlungen zur Kenntnis, um die Schaltung korrekt und sicher zu betreiben sowie Schäden und Verletzungen zu vermeiden:

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Diese Schaltung wurde als Laborausstattung entworfen, die nur von qualifizierten und eingewiesenen Technikern in Forschungsinstituten oder Entwicklungsabteilungen benutzt wird. Aus Sicherheitsgründen wird die Verwendung durch andere Personen oder in anderer Umgebung *nicht* empfohlen.

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- Diese Schaltung verwendet Kleinspannung ( $< 50 V_{AC}$  und  $< 75 V_{DC}$ ) und unterliegt daher nicht den Bestimmungen der *Niederspannungsrichtlinie* (2006/95/EC).
  - Das Gerät enthält kein mechanisches Antriebssystem – die Bestimmungen der *Maschinenrichtlinie* (2006/42/EC) sind daher nicht anwendbar.
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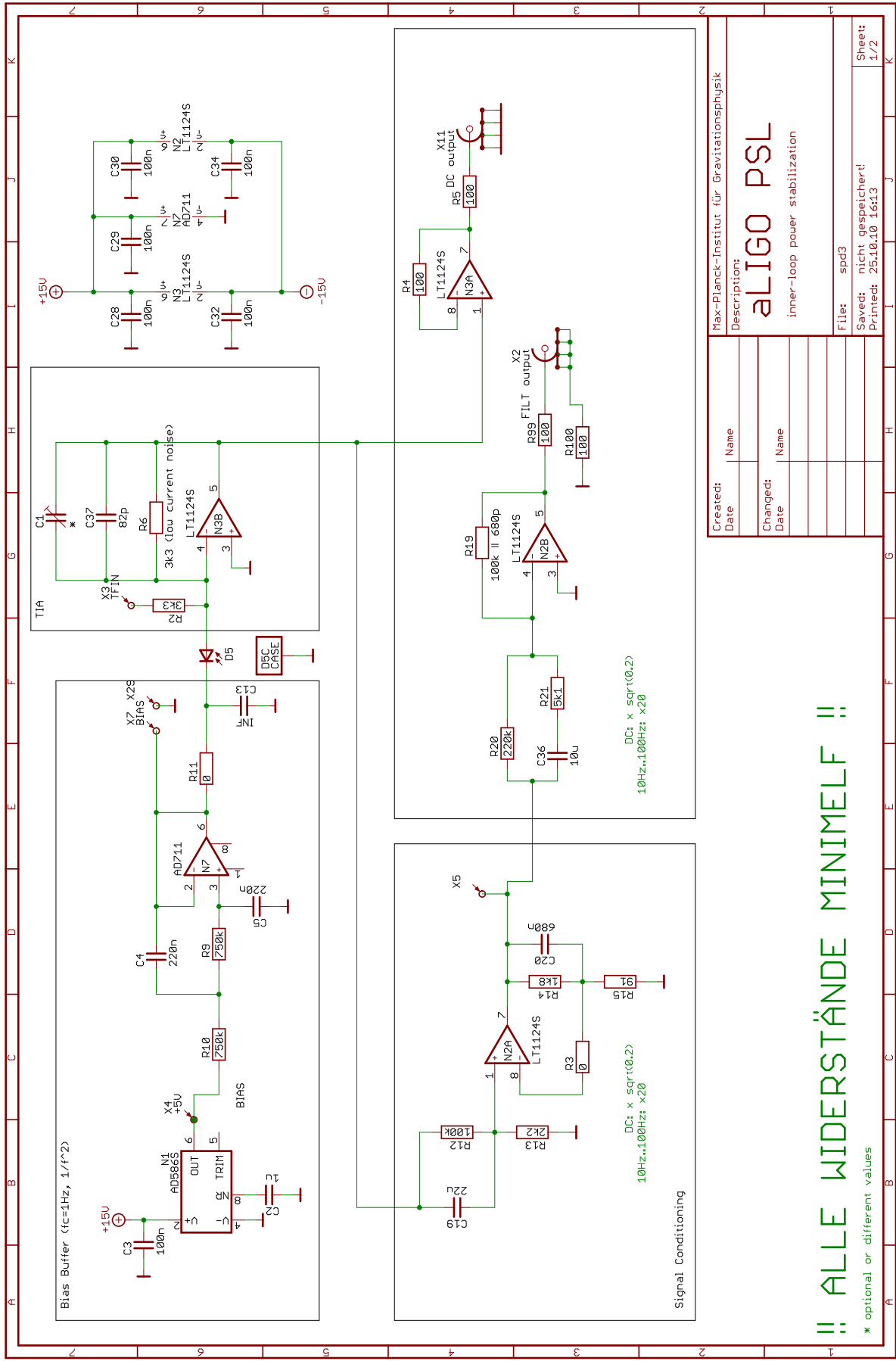


Figure 1: Project schematics (sheet 1)

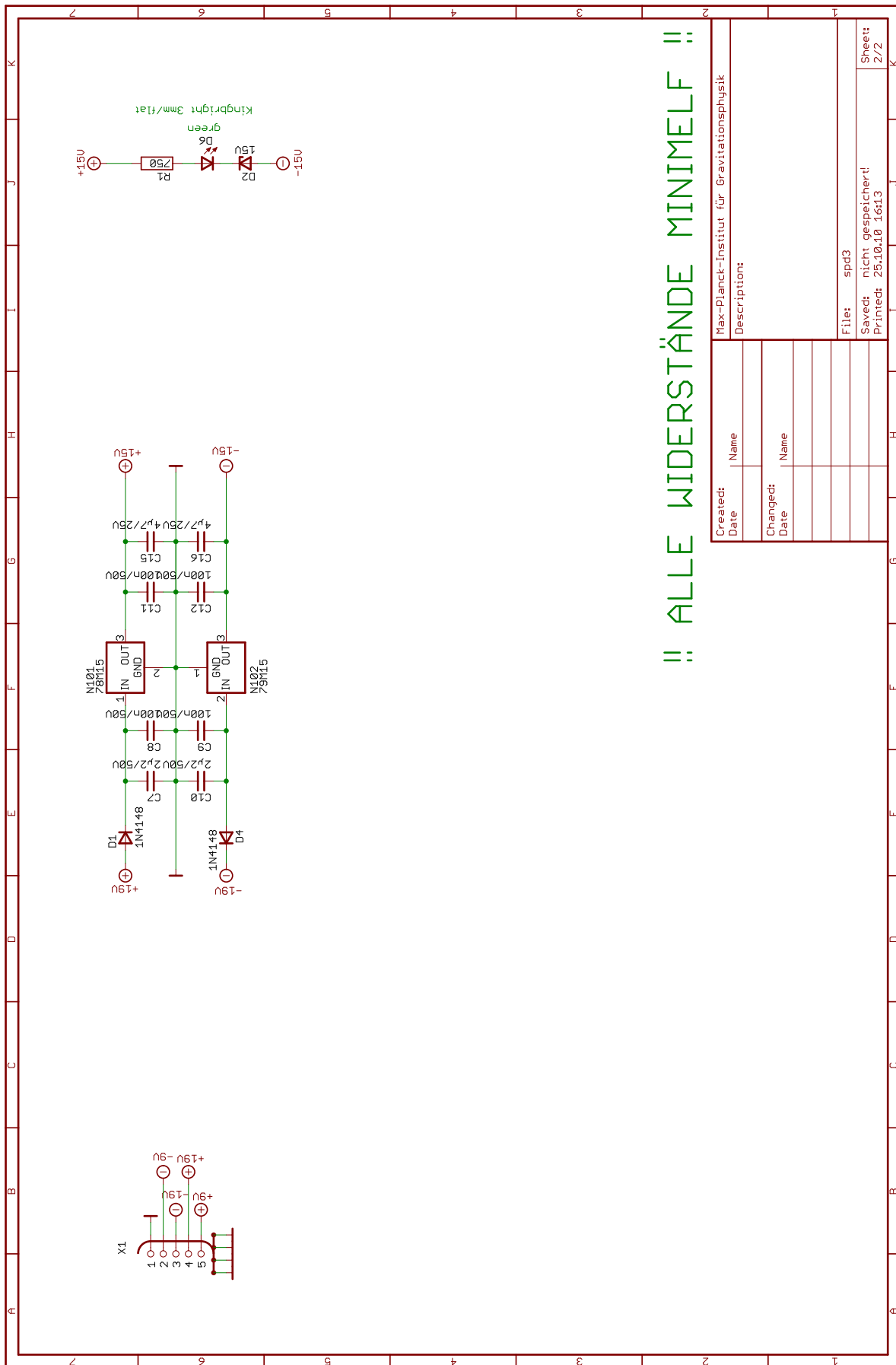


Figure 2: Project schematics (sheet 2)

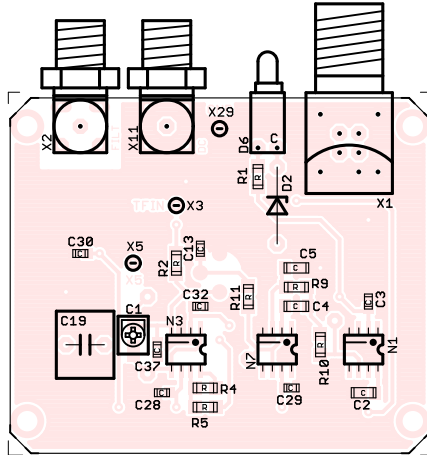
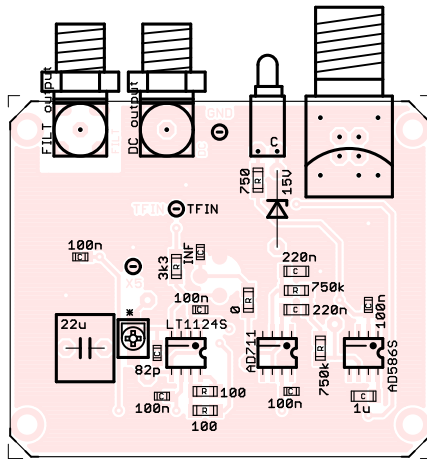


Figure 3: Board top view showing placeplan with component names



R = Minimelf

Figure 4: Board top view showing placeplan with component values

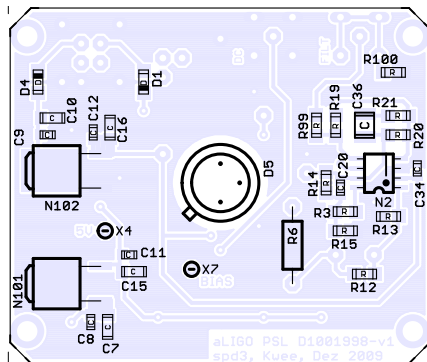
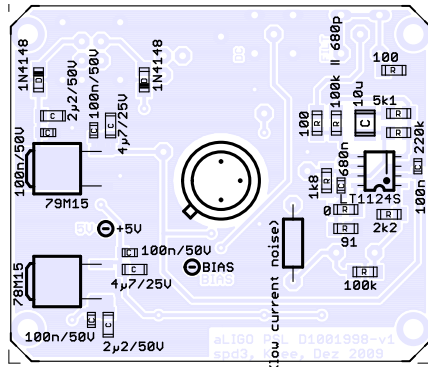


Figure 5: Board bottom view showing placeplan with component names



R = Minilab

Figure 6: Board bottom view showing placeplan with component values

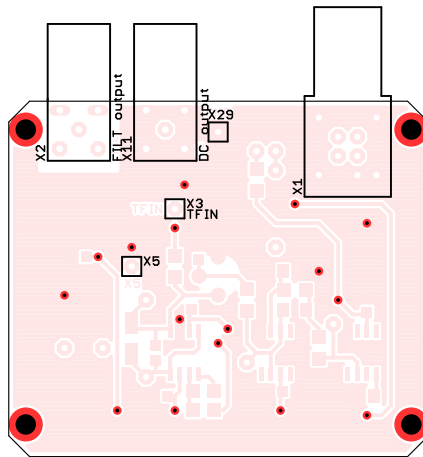


Figure 7: Board top view showing connectors, test points, vias and wired components

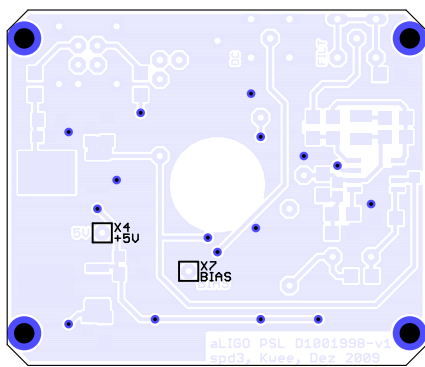
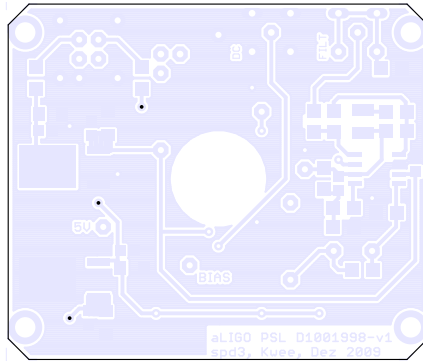
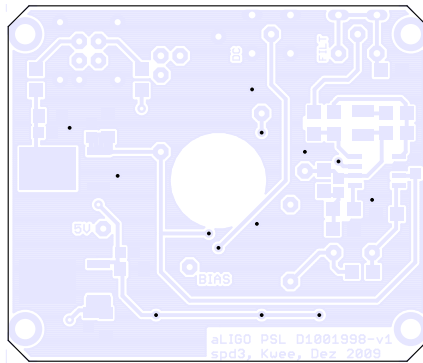


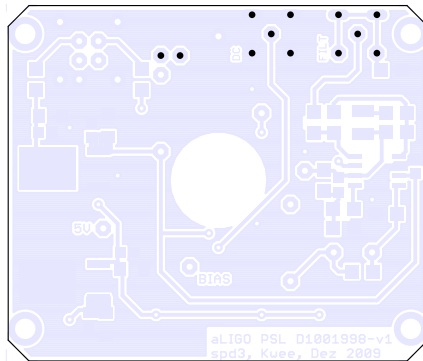
Figure 8: Board bottom view showing connectors, test points, vias and wired components



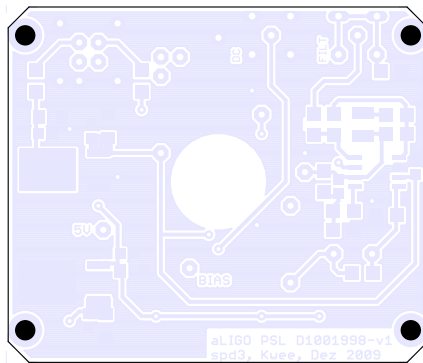
**Figure 9:** Board bottom view showing drills with 0.5 mm (0.020 in) diameter



**Figure 10:** Board bottom view showing drills with 0.5 mm (0.020 in) diameter



**Figure 11:** Board bottom view showing drills with 0.9 mm (0.035 in) diameter



**Figure 12:** Board bottom view showing drills with 2.7 mm (0.106 in) diameter

## Circuit Lists

**Drill list:** The following table shows all *final* drill diameters used in the board. When manually drilling the clearance holes, round up to the nearest available drill bit diameter, ensuring that all components fit well. When manufacturing *through-plated* boards, adjust for the additional copper coating by increasing the diameter accordingly.

∅ [μm]	∅ [mm]	∅ [in]	Count
500	0.5	0.020	3
508	0.5	0.020	13
812	0.8	0.032	23
889	0.9	0.035	12
2700	2.7	0.106	4
Total			55

**Table 1:** Drill diameters used in the board

**Standard properties:** If not explicitly stated otherwise in the schematics or value and part lists, the circuit components have the following standard properties. Parts with ‘better’ properties can be easily substituted, but care should be taken if the specifications are *not* met.

- Wired resistors: Metal film 0.6 W, 1%, 200 V, TK 100
- SMD resistors: 1%, 150 V, TK 50, MiniMELF in thin film, other packages in thick film technology

**Value list:** The following list shows all components available on the board (sorted by part *values*) and can be used to quickly gather components. Additional information can possibly be found directly on the board (or in the schematics).

```

1 EAGLE Version 5.10.0 Copyright (c) 1988-2010 CadSoft
2 Board value list of 'spd3.brd'
3 Exported at 2010-10-25 16:14
4 Created with macro 'plot.ulp' (c) Andreas Weidner
5 Shown are: Value/Type,Package,Number,Names (Library)
6
7 ---C---
8 82p          C-SMD:0805      (1*)   C37 (DIVERS)
9 100n         C-SMD:0805      (6*)   C3,C28,C29,C30,C32,C34 (DIVERS)
10 100n/50V    C-SMD:0805      (4*)   C8,C9,C11,C12 (DIVERS)
11 220n        C-SMD:1206      (2*)   C4,C5 (DIVERS)
12 680n        C-SMD:0805      (1*)   C20 (DIVERS)
13 1u          C-SMD:1206      (1*)   C2 (DIVERS)
14 2u2/50V    C-SMD:1206      (2*)   C7,C10 (DIVERS)
15 4u7/25V    C-SMD:1206      (2*)   C15,C16 (DIVERS)
16 10u         C-SMD:1210      (1*)   C36 (DIVERS)
17 22u         C-WIMA:MKS2-0.2" (1*)   C19 (DIVERS)
18 *          CT4MM           (1*)   C1 (DIVERS)
19 INF        C-SMD:0805      (1*)   C13 (DIVERS)
20
21 ---D---
22 1N4148      D-SMD:MiniMELF  (2*)   D1,D4 (DIVERS)
23 15V         DZ-0.4"         (1*)   D2 (DIVERS)
24 [undefined] DL2N            (1*)   D6 (opto)
25            TO-5             (1*)   D5 (opto)
26
27 ---N---
28 78M15      TO-252          (1*)   N101 (IC)
29 79M15      TO-252          (1*)   N102 (IC)
30 AD586S     SO-8            (1*)   N1 (IC)

```



31	AD711	SO-8	(1*)	N7 (opamps)
32	LT1124S	SO-8	(2*)	N2,N3 (opamps)
33				
34	---R---			
35	0	R-SMD:MiniMELF	(2*)	R3,R11 (DIVERS)
36	91	R-SMD:MiniMELF	(1*)	R15 (DIVERS)
37	100	R-SMD:MiniMELF	(4*)	R4,R5,R99,R100 (DIVERS)
38	750	R-SMD:MiniMELF	(1*)	R1 (DIVERS)
39	1k8	R-SMD:MiniMELF	(1*)	R14 (DIVERS)
40	2k2	R-SMD:MiniMELF	(1*)	R13 (DIVERS)
41	3k3	R-SMD:MiniMELF	(1*)	R2 (DIVERS)
42	3k3 (low current noise)	R-0.4"	(1*)	R6 (DIVERS)
43	5k1	R-SMD:MiniMELF	(1*)	R21 (DIVERS)
44	100k	R-SMD:MiniMELF	(1*)	R12 (DIVERS)
45	100k    680p	R-SMD:MiniMELF	(1*)	R19 (DIVERS)
46	220k	R-SMD:MiniMELF	(1*)	R20 (DIVERS)
47	750k	R-SMD:MiniMELF	(2*)	R9,R10 (DIVERS)
48				
49	---X---			
50	+5V	Testpin	(1*)	X4 (connectors)
51	BIAS	Testpin	(1*)	X7 (connectors)
52	DC output	LEMO:1-pin/horz.	(1*)	X11 (connectors)
53	FILT output	LEMO:1-pin/horz.	(1*)	X2 (connectors)
54	TFIN	Testpin	(1*)	X3 (connectors)
55	[undefined]	Testpin	(2*)	X5,X29 (connectors)
56		XLEMO05N	(1*)	X1 (connectors)

**Part list:** The following list shows all components available in the schematics (sorted by part *names*) and can be used to quickly locate components. The column *Layer/Cell* shows the position of the part on the board: *T* for top side and *B* for bottom side, followed by the cell of the surrounding frame (if available). The column *Sheets/Cells* shows the position of *all* the part's gates in the schematics: Sheet number followed by the cell of the surrounding frame (if available). Additional information can possibly be found directly in the schematics.

```

1 EAGLE Version 5.10.0 Copyright (c) 1988-2010 CadSoft
2 Schematics part list of 'spd3.sch'
3 Exported at 2010-10-25 16:14
4 Created with macro 'plot.ulp' (c) Andreas Weidner
5 Shown are: Name,Value/Type,Package,Device,Layer/Cell,Sheets/Cells
6
7 ---C---
8 C1      *          CT4MM          CT2S          T  1
9 C2      1u         C-SMD:1206     C1206         T  1
10 C3     100n       C-SMD:0805     CS            T  1
11 C4     220n       C-SMD:1206     C1206         T  1
12 C5     220n       C-SMD:1206     C1206         T  1
13 C7     2u2/50V    C-SMD:1206     C1206         B  2
14 C8     100n/50V  C-SMD:0805     C0805         B  2
15 C9     100n/50V  C-SMD:0805     C0805         B  2
16 C10    2u2/50V   C-SMD:1206     C1206         B  2
17 C11    100n/50V  C-SMD:0805     C0805         B  2
18 C12    100n/50V  C-SMD:0805     C0805         B  2
19 C13    INF       C-SMD:0805     CS            T  1
20 C15    4u7/25V   C-SMD:1206     C1206         B  2
21 C16    4u7/25V   C-SMD:1206     C1206         B  2
22 C19    22u       C-WIMA:MKS2-0.2" C02C         T  1
23 C20    680n      C-SMD:0805     CS            B  1
24 C28    100n      C-SMD:0805     CS            T  1
25 C29    100n      C-SMD:0805     CS            T  1

```

26	C30	100n	C-SMD:0805	CS	T	1
27	C32	100n	C-SMD:0805	CS	T	1
28	C34	100n	C-SMD:0805	CS	B	1
29	C36	10u	C-SMD:1210	C1210	B	1
30	C37	82p	C-SMD:0805	CS	T	1
31						
32	---D---					
33	D1	1N4148	D-SMD:MiniMELF	DMINIMELF	B	2
34	D2	15V	DZ-0.4"	DZ04N	T	2
35	D4	1N4148	D-SMD:MiniMELF	DMINIMELF	B	2
36	D5	[undefined]	TO-5	DP-C-C30642B	B	1
37	D6	[undefined]	DL2N	DL2	T	2
38						
39	---N---					
40	N1	AD586S	SO-8	AD586S	T	1
41	N2	LT1124S	SO-8	LT1124S	B	1
42	N3	LT1124S	SO-8	LT1124S	T	1
43	N7	AD711	SO-8	OP27S	T	1
44	N101	78M15	TO-252	78XXS2	B	2
45	N102	79M15	TO-252	79XXS2	B	2
46						
47	---R---					
48	R1	750	R-SMD:MiniMELF	RMINIMELF	T	2
49	R2	3k3	R-SMD:MiniMELF	RMINIMELF	T	1
50	R3	0	R-SMD:MiniMELF	RMINIMELF	B	1
51	R4	100	R-SMD:MiniMELF	RMINIMELF	T	1
52	R5	100	R-SMD:MiniMELF	RMINIMELF	T	1
53	R6	3k3 (low current noise)	R-0.4"	R	B	1
54	R9	750k	R-SMD:MiniMELF	RMINIMELF	T	1
55	R10	750k	R-SMD:MiniMELF	RMINIMELF	T	1
56	R11	0	R-SMD:MiniMELF	RMINIMELF	T	1
57	R12	100k	R-SMD:MiniMELF	RMINIMELF	B	1
58	R13	2k2	R-SMD:MiniMELF	RMINIMELF	B	1
59	R14	1k8	R-SMD:MiniMELF	RMINIMELF	B	1
60	R15	91	R-SMD:MiniMELF	RMINIMELF	B	1
61	R19	100k    680p	R-SMD:MiniMELF	RMINIMELF	B	1
62	R20	220k	R-SMD:MiniMELF	RMINIMELF	B	1
63	R21	5k1	R-SMD:MiniMELF	RMINIMELF	B	1
64	R99	100	R-SMD:MiniMELF	RMINIMELF	B	1
65	R100	100	R-SMD:MiniMELF	RMINIMELF	B	1
66						
67	---X---					
68	X1	[undefined]	XLEM005N	XS05-4S	T	2
69	X2	FILT output	LEMO:1-pin/horz.	XS-4S-LEM000HL	T	1
70	X3	TFIN	Testpin	XT	T	1
71	X4	+5V	Testpin	XT	B	1
72	X5	[undefined]	Testpin	XT	T	1
73	X7	BIAS	Testpin	XT	B	1
74	X11	DC output	LEMO:1-pin/horz.	XS-4S-LEM000HL	T	1
75	X29	[undefined]	Testpin	XT	T	1