

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:



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.



- 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:



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.



- 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.
-

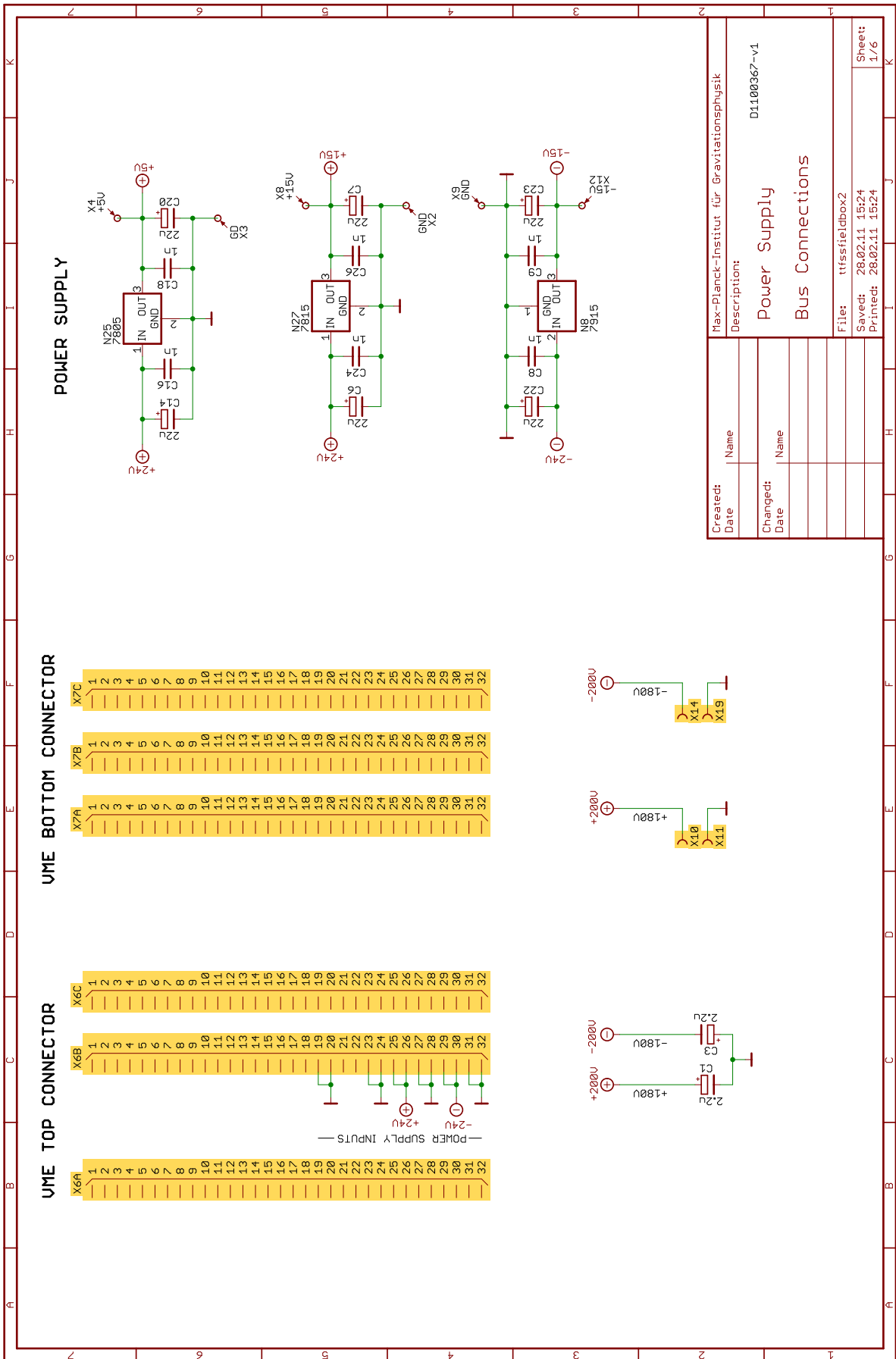


Figure 1: Project schematics (sheet 1)
 Parts with undefined values are highlighted in orange

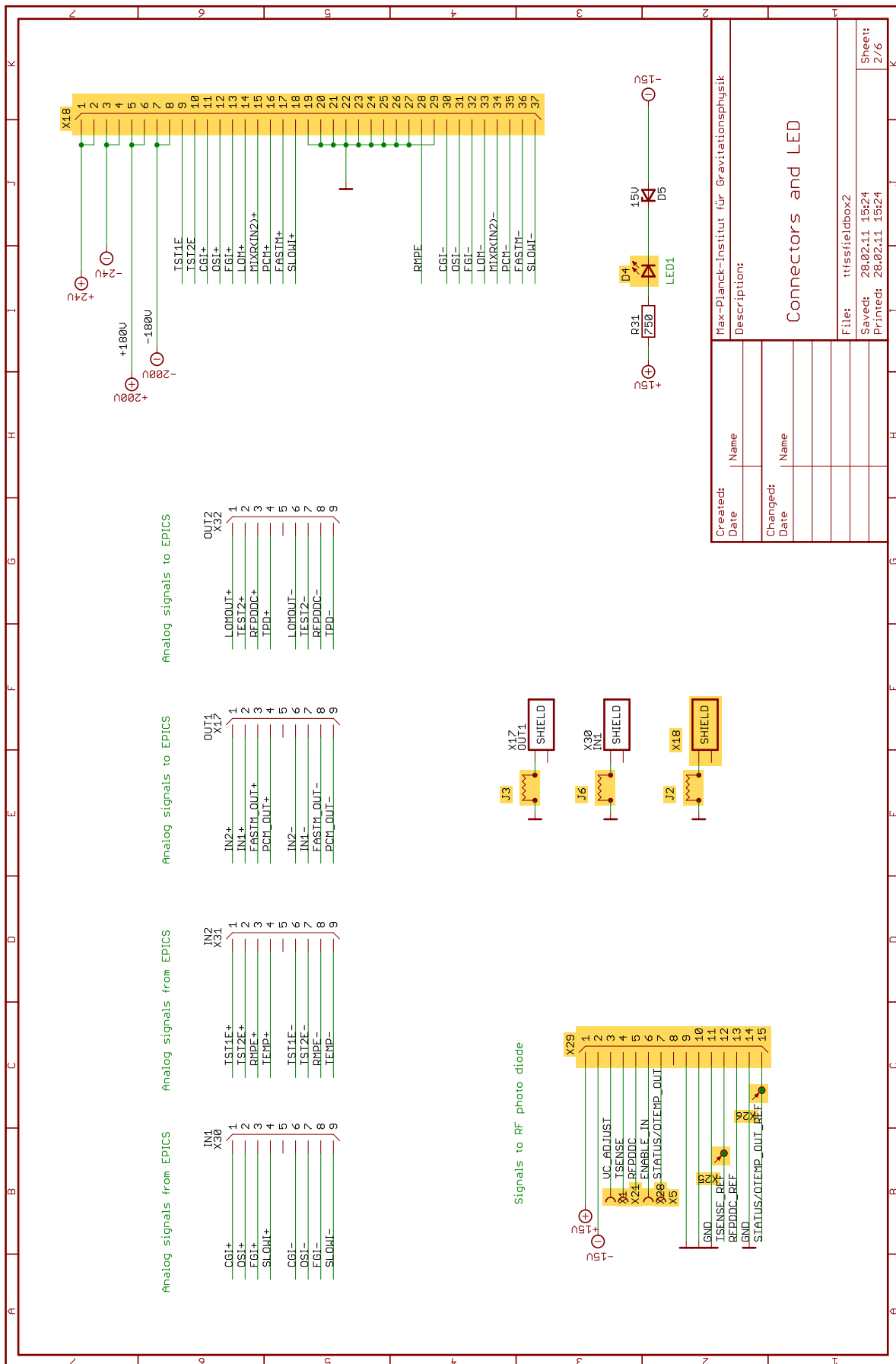


Figure 2: Project schematics (sheet 2)
 Parts with undefined values are highlighted in orange

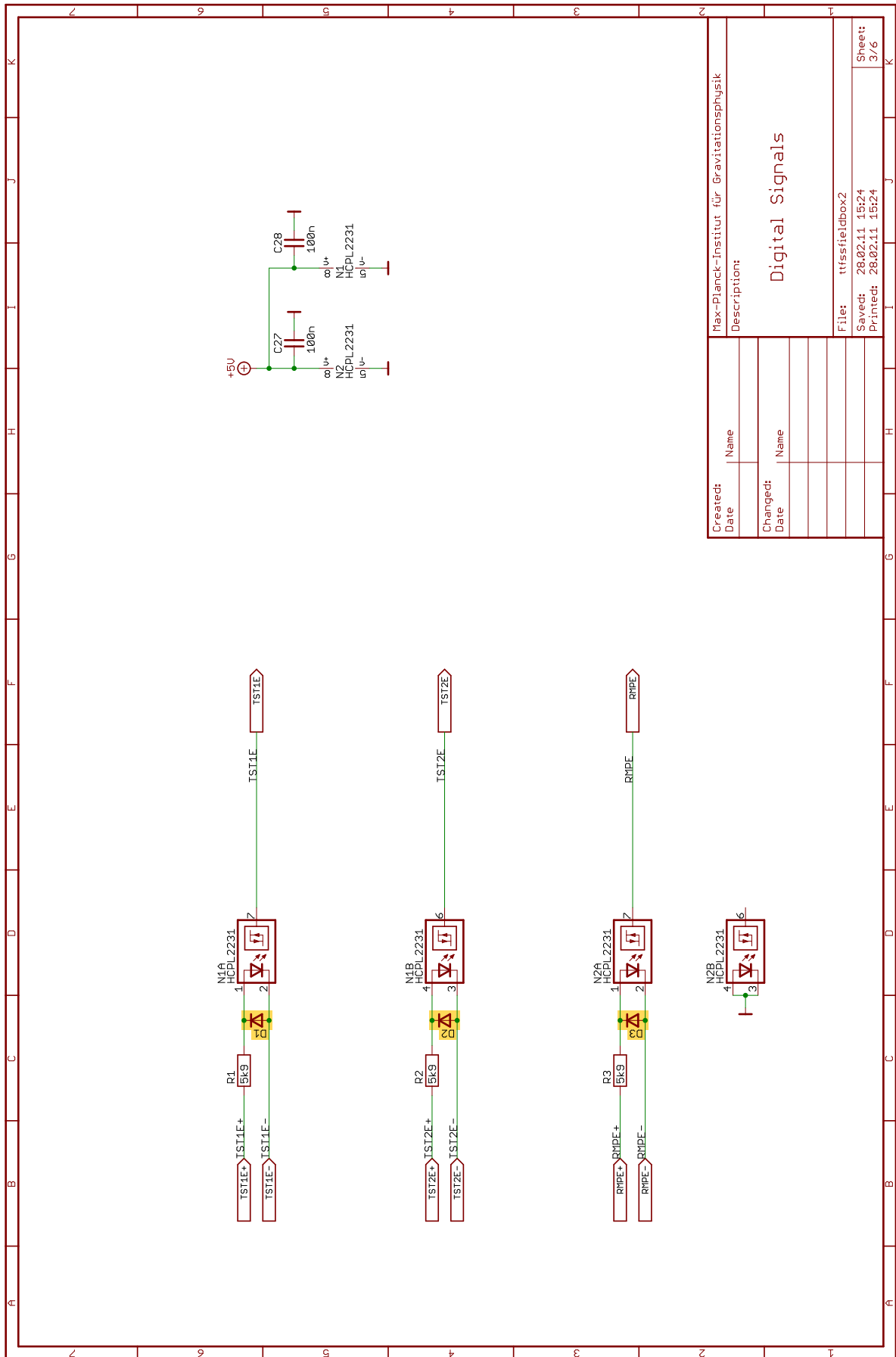
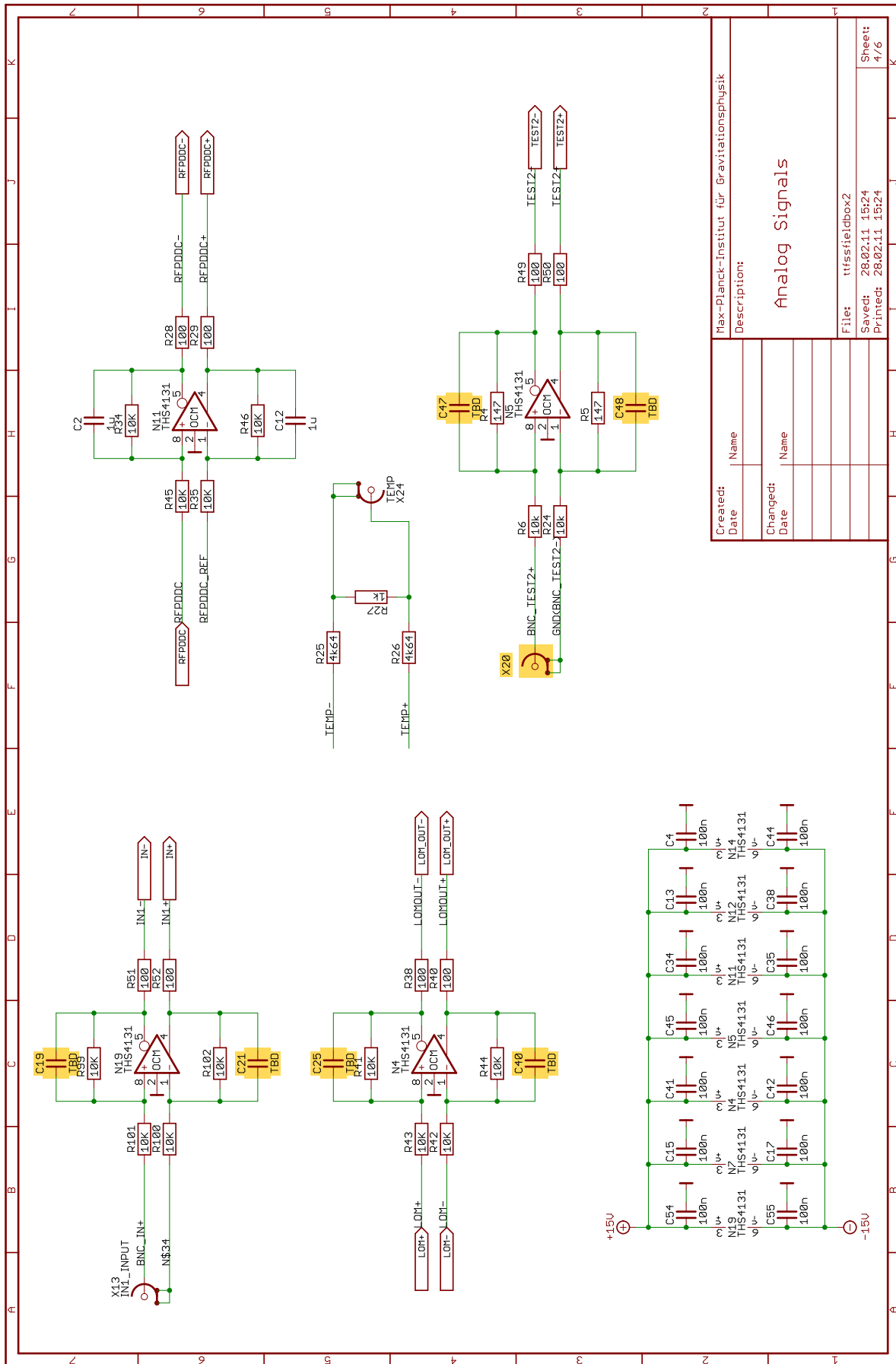


Figure 3: Project schematics (sheet 3)
 Parts with undefined values are highlighted in orange



Created:	Date	Name	Max-Planck-Institut für Gravitationsphysik
Changed:	Date	Name	Analog Signals
File:	ttfssfieldbox2		
Saved:	28.02.11	15:24	Sheet: 4/6
Printed:	28.02.11	15:24	

Figure 4: Project schematics (sheet 4)

Parts with undefined values are highlighted in orange

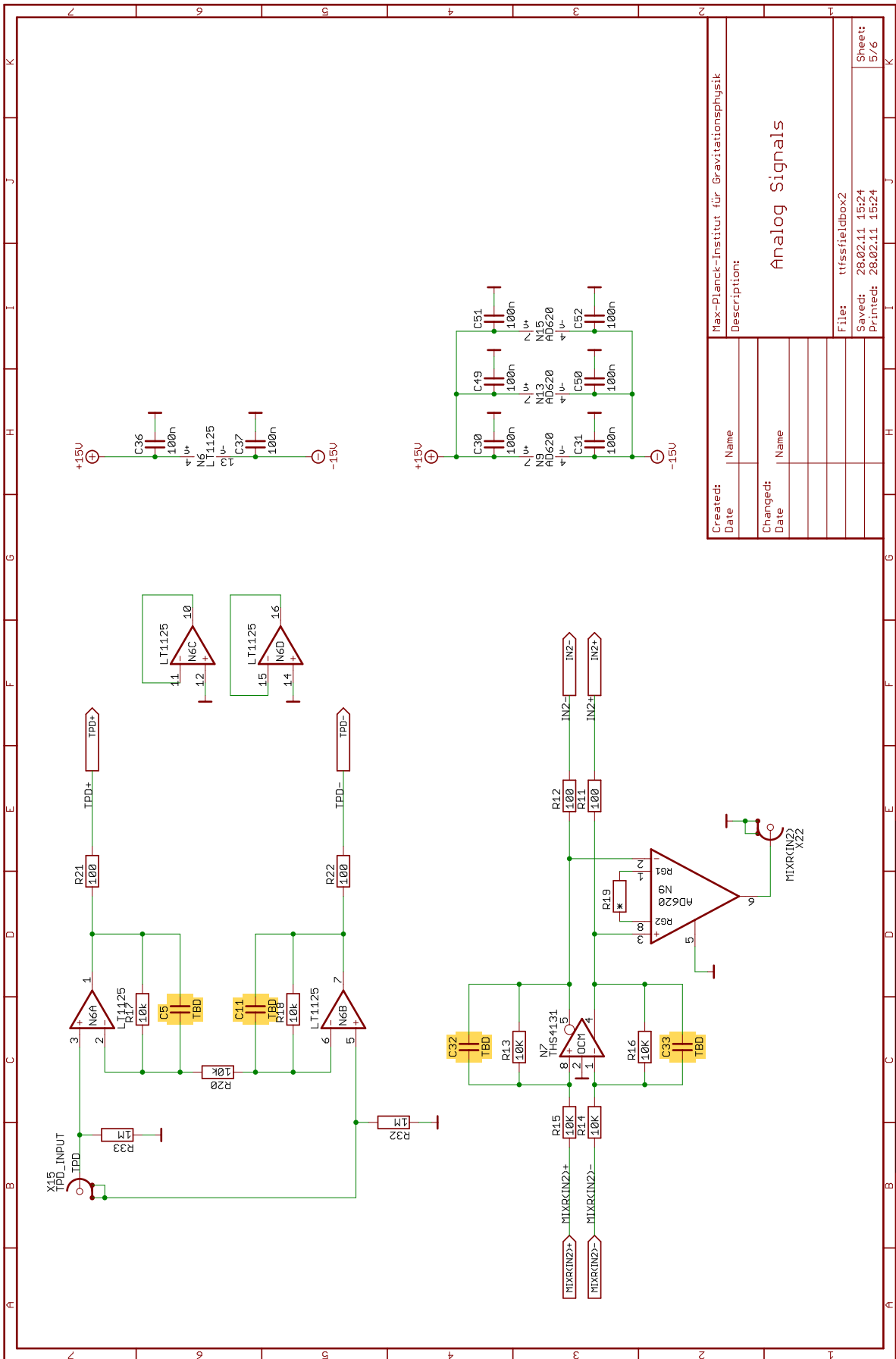


Figure 5: Project schematics (sheet 5)
Parts with undefined values are highlighted in orange

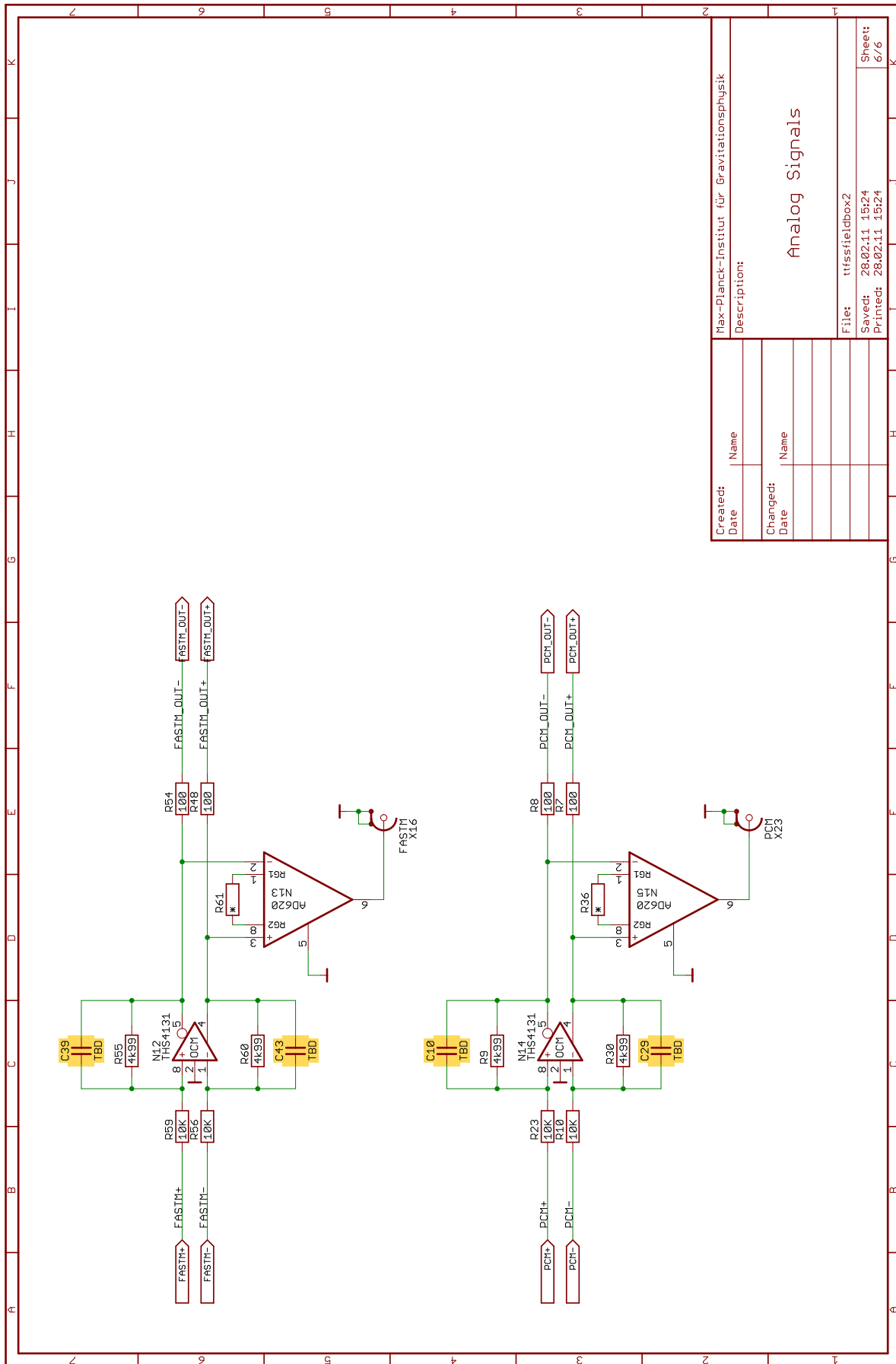


Figure 6: Project schematics (sheet 6)
 Parts with undefined values are highlighted in orange

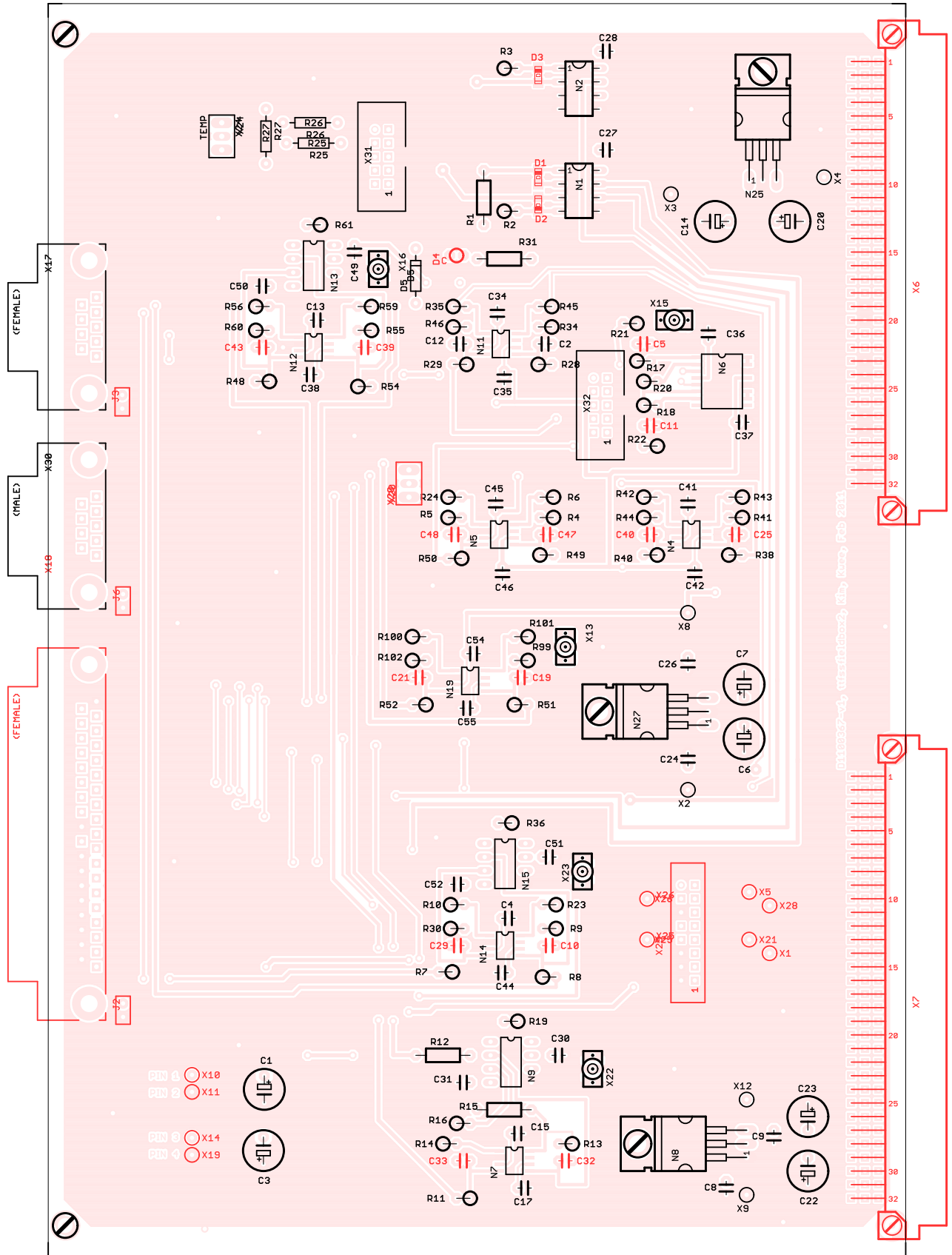


Figure 7: Board top view showing placeplan with component names
 Components with undefined values are shown in red

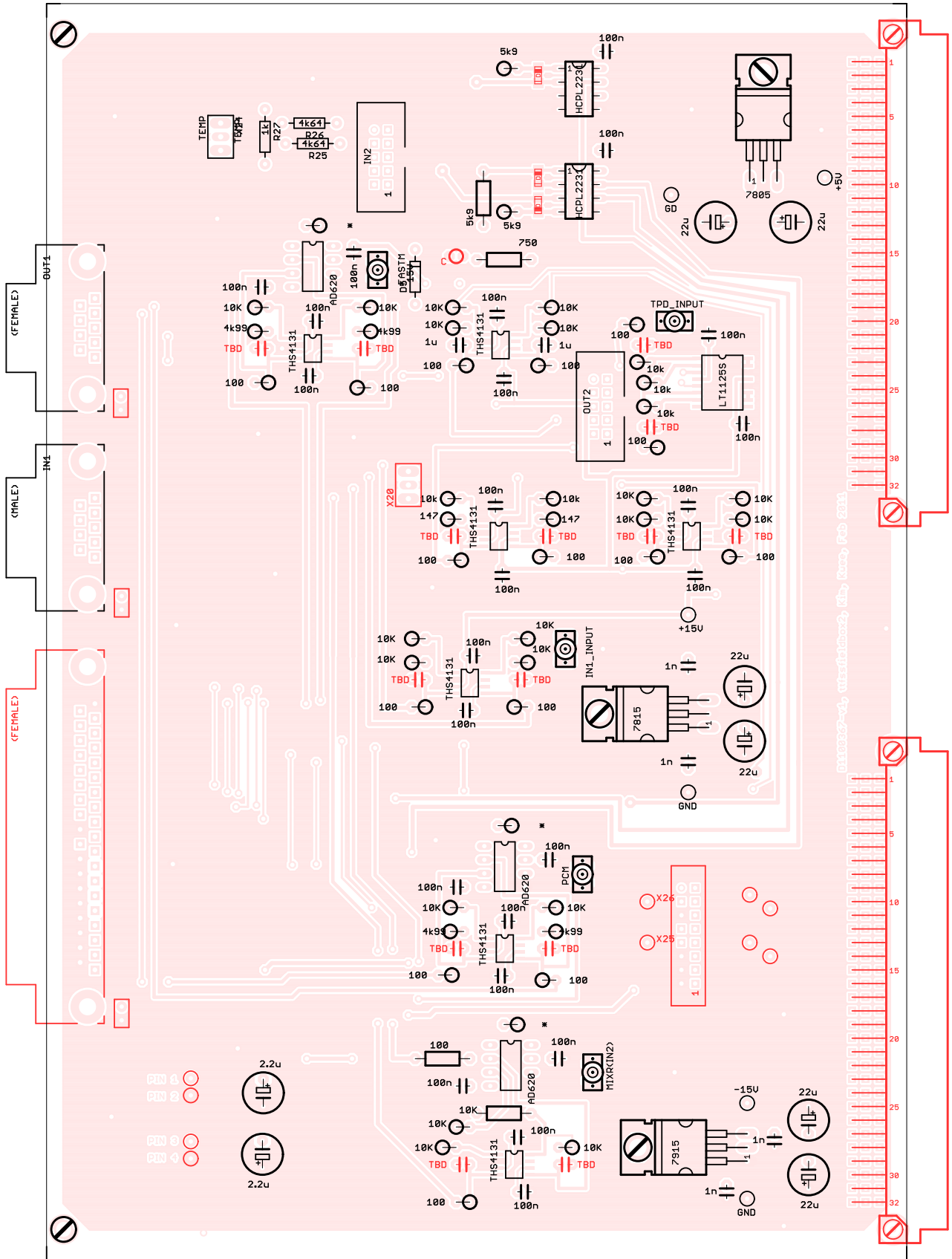


Figure 8: Board top view showing placeplan with component values
 Components with undefined values are shown in red

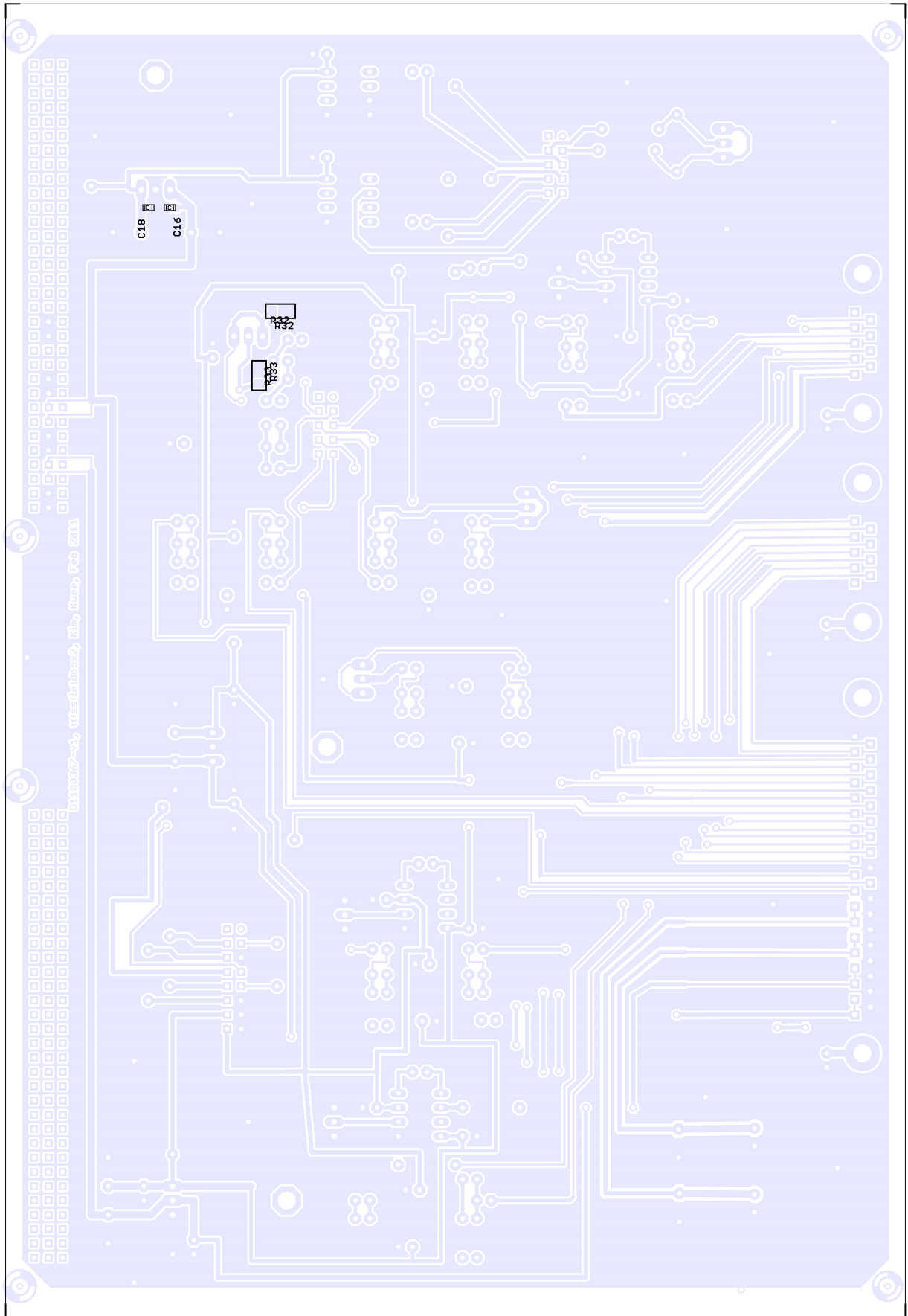


Figure 9: Board bottom view showing placeplan with component names
Components with undefined values are shown in blue

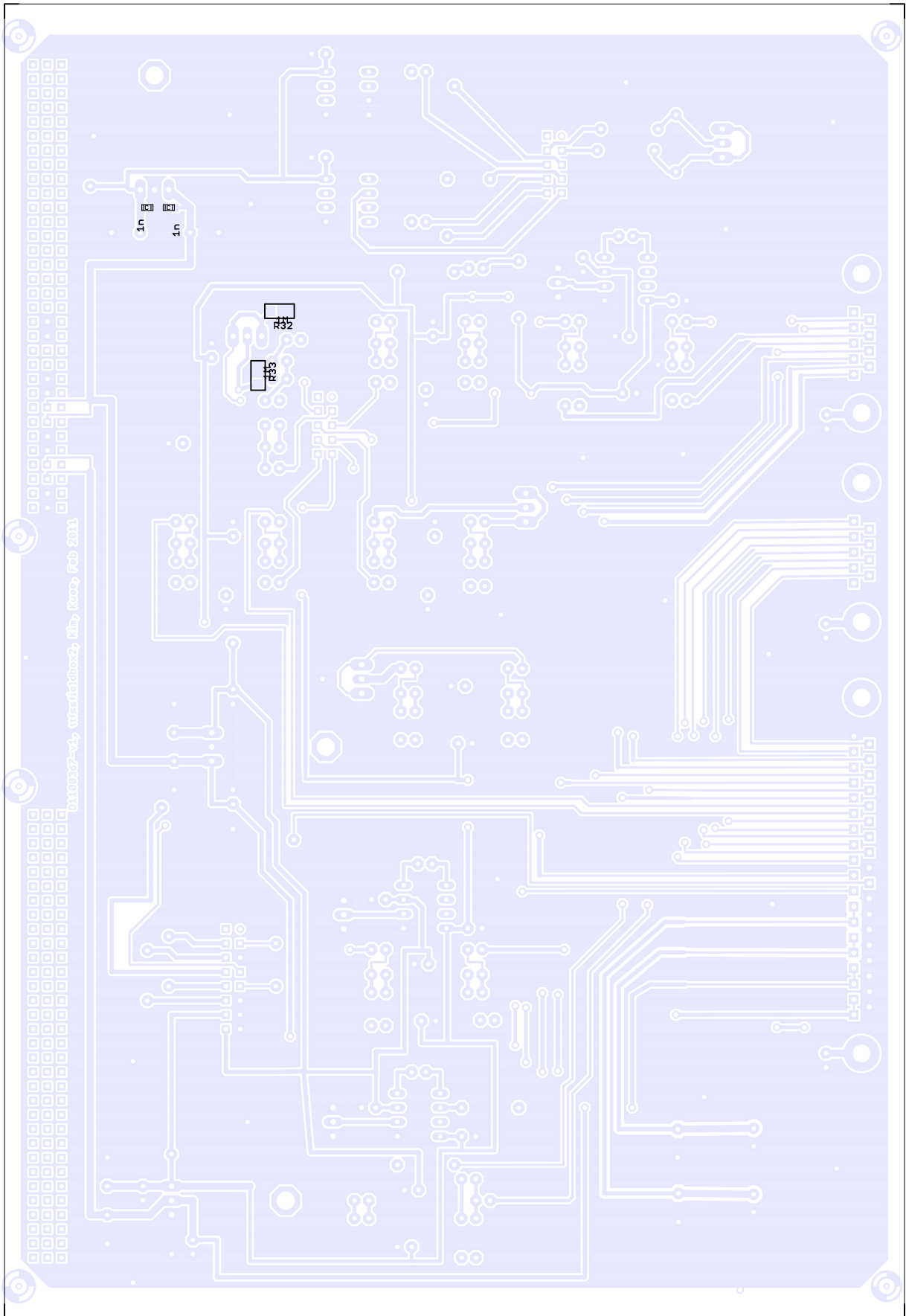


Figure 10: Board bottom view showing placeplan with component values
Components with undefined values are shown in blue

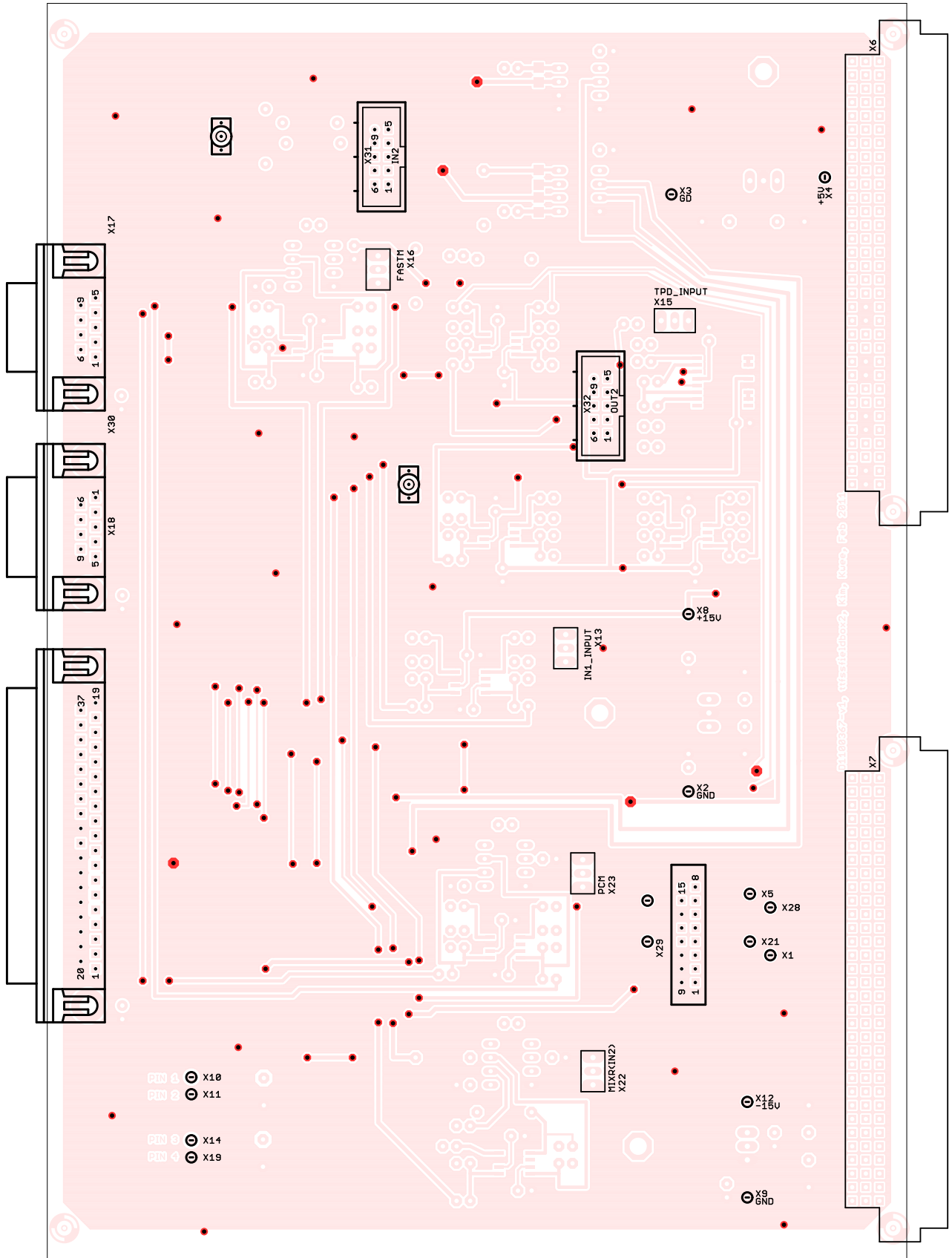


Figure 11: Board top view showing connectors, test points, vias and wired components

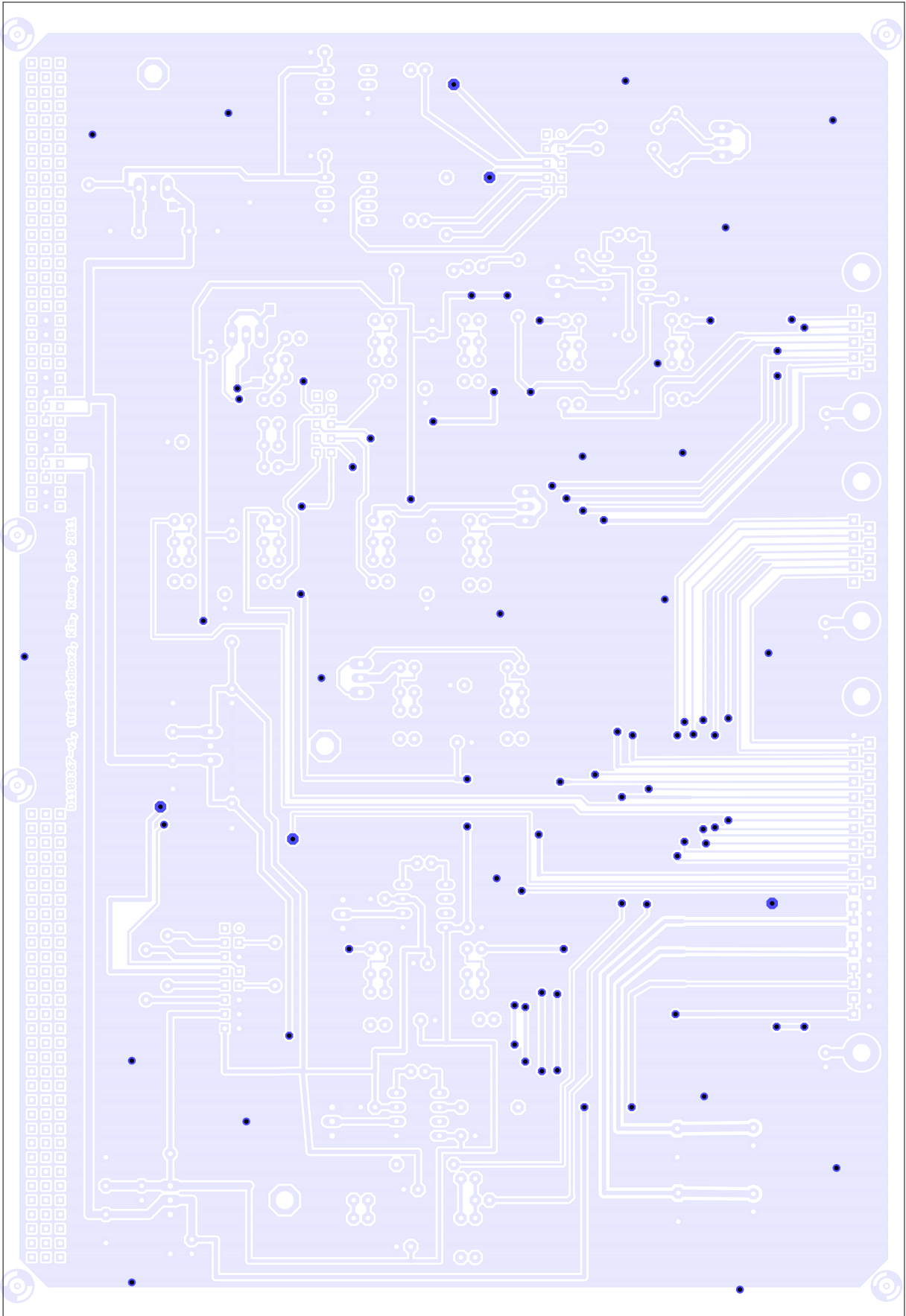


Figure 12: Board bottom view showing connectors, test points, vias and wired components

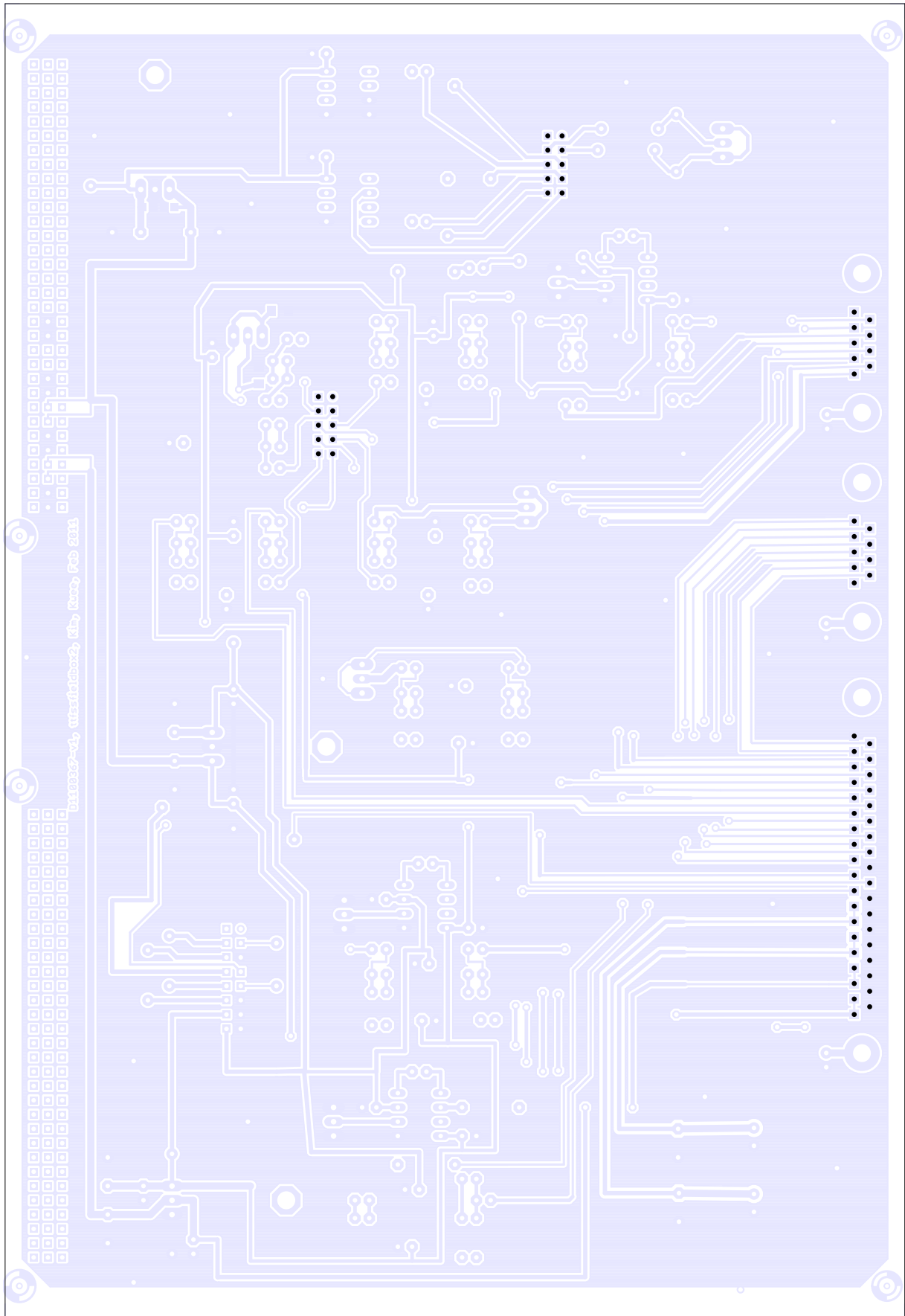


Figure 13: Board bottom view showing drills with 0.9 mm (0.035 in) diameter

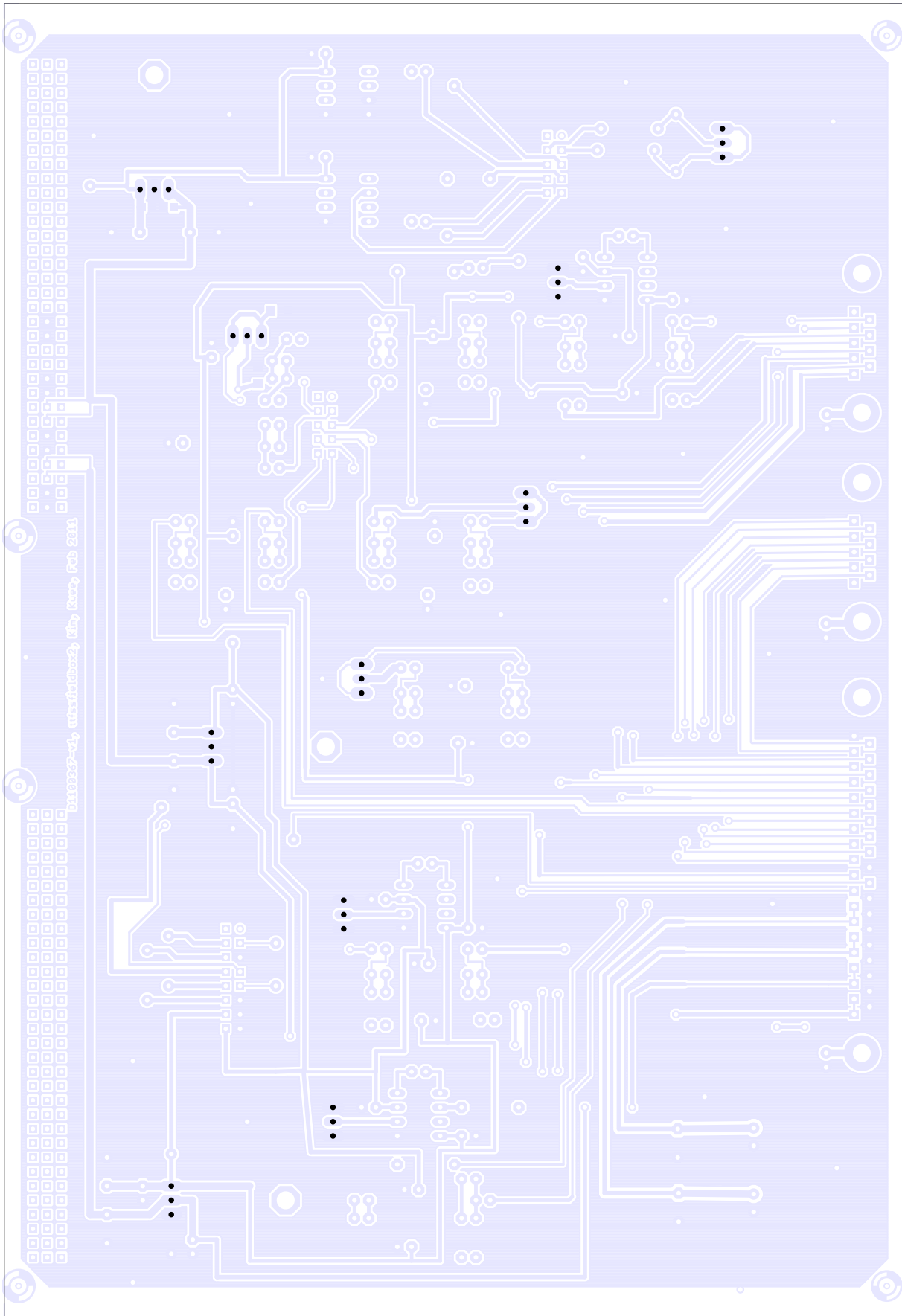


Figure 14: Board bottom view showing drills with 1.0 mm (0.039 in) diameter

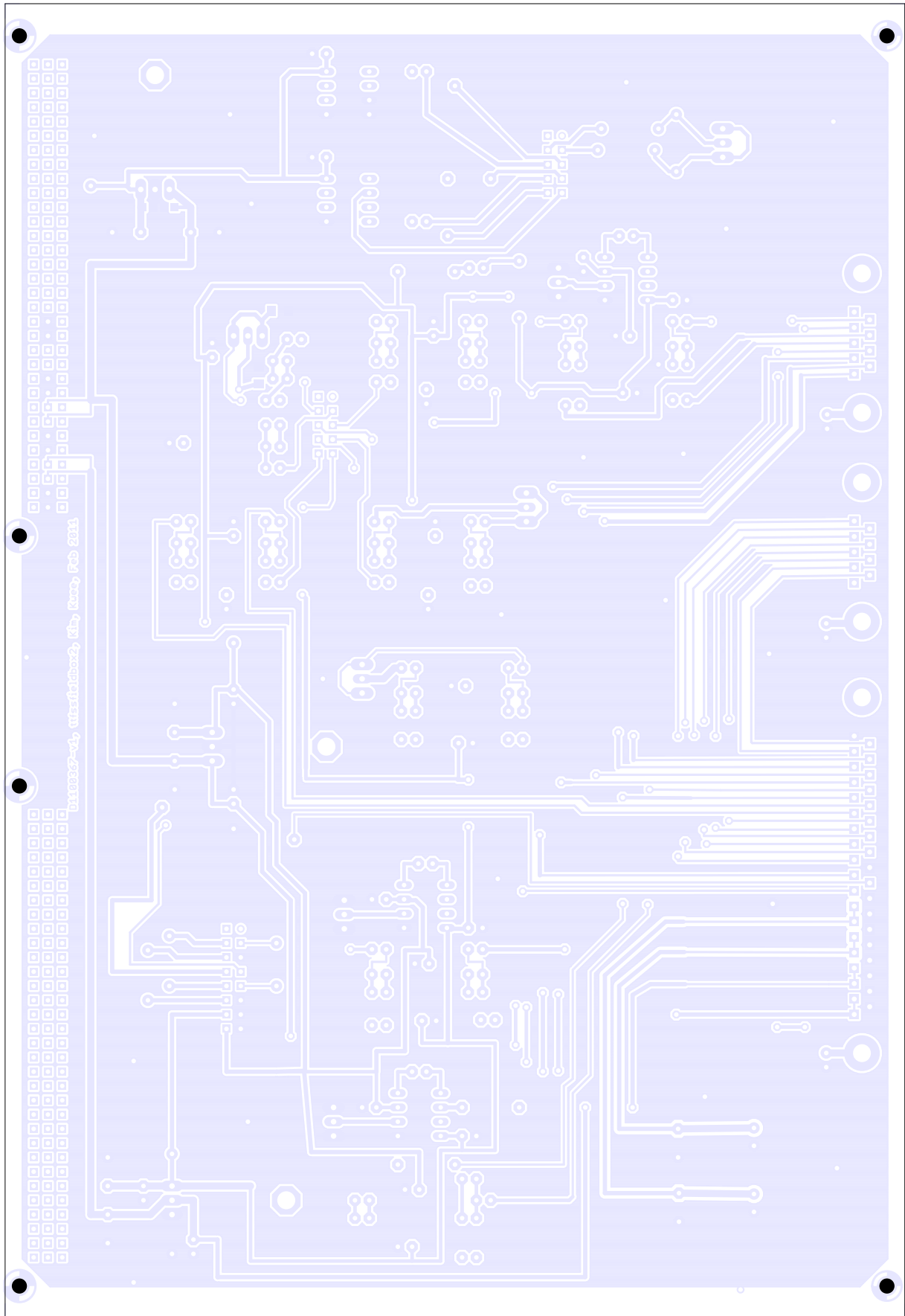


Figure 15: Board bottom view showing drills with 2.7 mm (0.106 in) diameter

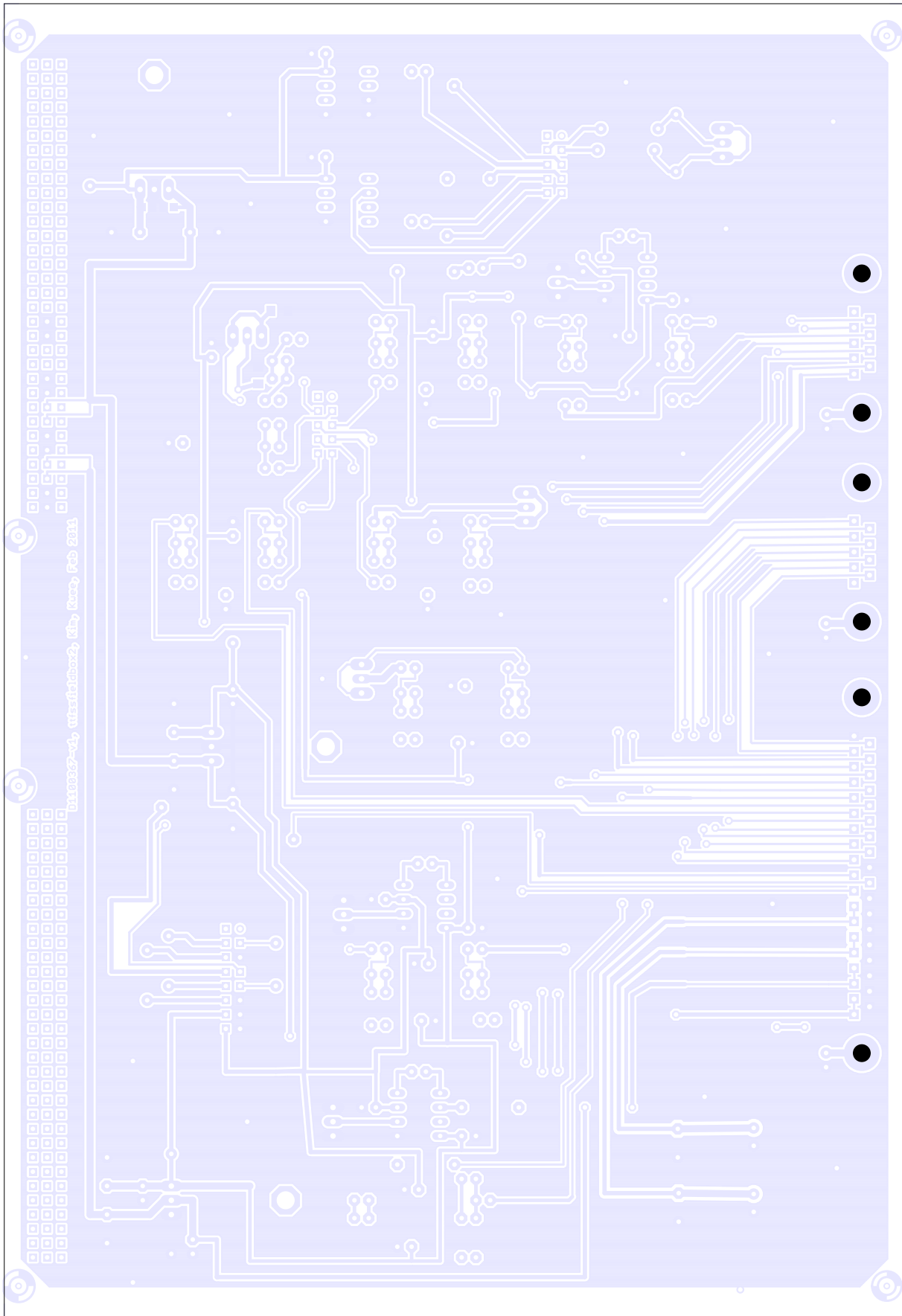


Figure 16: Board bottom view showing drills with 3.2 mm (0.125 in) diameter

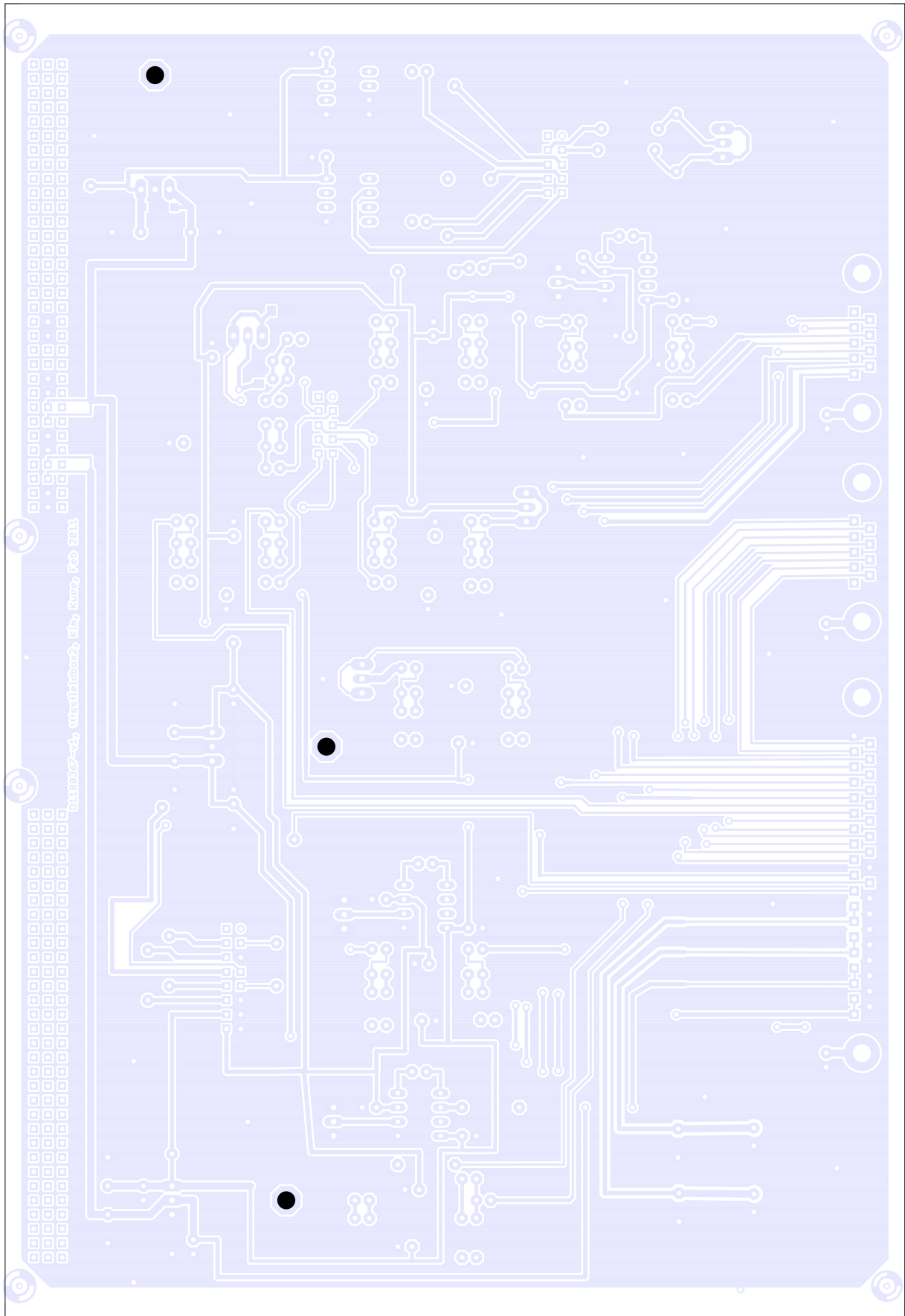


Figure 17: Board bottom view showing drills with 3.2 mm (0.126 in) diameter

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.

\varnothing [μm]	\varnothing [mm]	\varnothing [in]	Count
812	0.8	0.032	582
889	0.9	0.035	75
990	1.0	0.039	30
2692	2.7	0.106	6
3175	3.2	0.125	6
3200	3.2	0.126	3
Total			702

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. Names of components with undefined values are shown in **red**. Additional information can possibly be found directly on the board (or in the schematics).

```

1 EAGLE Version 5.11.0 Copyright (c) 1988-2010 CadSoft
2 Board value list of 'ttfssfieldbox2.brd'
3 Exported at 2011-02-28 15:24
4 Created with macro 'plot.ulp' (c) Andreas Weidner
5 Shown are: Value/Type,Package,Number,Names (Library)
6
7 ---C---
8 1n          C-0.1"          (4*)   C8,C9,C24,C26 (divers)
9            C-SMD:0805      (2*)   C16,C18 (divers)
10 100n        C-0.1"          (24*)  C4,C13,C15,C17,C27,C28,C30,C31,C34,C35,
11            C36,C37,C38,C41,C42,C44,C45,C46,C49,C50,
12            C51,C52,C54,C55 (divers)
13 1u          C-0.1"          (2*)   C2,C12 (divers)
14 2.2u        CE-TANTAL:0.2" (2*)   C1,C3 (divers)
15 22u         CE-TANTAL:0.2" (6*)   C6,C7,C14,C20,C22,C23 (divers)
16 [undefined] C-0.1"          (14*)  C5,C10,C11,C19,C21,C25,C29,C32,C33,C39,
17            C40,C43,C47,C48 (divers)
18
19 ---D---
20 15V         DZ-0.4"          (1*)   D5 (diodes)
21 [undefined] D-SMD:MiniMELF (3*)   D1,D2,D3 (divers)
22            LED-3mm        (1*)   D4 (opto)
23
24 ---J---
25 [undefined] JMP:Wire-0.1" (3*)   J2,J3,J6 (connectors)
26
27 ---N---
28 7805        TO-220          (1*)   N25 (ic)
29 7815        TO-220          (1*)   N27 (ic)

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30	7915	T0-220	(1*)	N8 (ic)
31	AD620	DIP-8	(3*)	N9,N13,N15 (opamps)
32	HCPL2231	DIP-8	(2*)	N1,N2 (ic_neu)
33	LT1125	SO16W	(1*)	N6 (opamps)
34	THS4131	SO-8	(7*)	N4,N5,N7,N11,N12,N14,N19 (opamps)
35				
36	---R---			
37	100	R-0.1"	(15*)	R7,R8,R11,R21,R22,R28,R29,R38,R40,R48,R49, R50,R51,R52,R54 (divers)
38				
39		R-0.4"	(1*)	R12 (divers)
40	147	R-0.1"	(2*)	R4,R5 (divers)
41	750	R-0.4"	(1*)	R31 (divers)
42	1k	R-0.4"	(1*)	R27 (miscs)
43	4k64	R-0.4"	(2*)	R25,R26 (miscs)
44	4k99	R-0.1"	(4*)	R9,R30,R55,R60 (divers)
45	5k9	R-0.1"	(2*)	R2,R3 (divers)
46		R-0.4"	(1*)	R1 (divers)
47	10K	R-0.1"	(19*)	R10,R13,R14,R16,R23,R34,R35,R41,R42,R43, R44,R45,R46,R56,R59,R99,R100,R101,R102 (divers)
48				
49				
50		R-0.4"	(1*)	R15 (divers)
51	10k	R-0.1"	(5*)	R6,R17,R18,R20,R24 (divers)
52	1M	R-SMD:1206	(2*)	R32,R33 (miscs)
53	*	R-0.1"	(3*)	R19,R36,R61 (divers)
54				
55	---X---			
56	-15V	Testpin:0.8mm/ceramic	(1*)	X12 (connectors)
57	+5V	Testpin:0.8mm/ceramic	(1*)	X4 (connectors)
58	+15V	Testpin:0.8mm/ceramic	(1*)	X8 (connectors)
59	FASTM	Crimp:RG174/vert.	(1*)	X16 (connectors)
60	GD	Testpin:0.8mm/ceramic	(1*)	X3 (connectors)
61	GND	Testpin:0.8mm/ceramic	(2*)	X2,X9 (connectors)
62	IN1	D-SUB:9-pin/US/male	(1*)	X30 (connectors)
63	IN1_INPUT	Crimp:RG174/vert.	(1*)	X13 (connectors)
64	IN2	IDC:10-pin/vert.	(1*)	X31 (connectors)
65	MIXR(IN2)	Crimp:RG174/vert.	(1*)	X22 (connectors)
66	OUT1	D-SUB:9-pin/US/female	(1*)	X17 (connectors)
67	OUT2	IDC:10-pin/vert.	(1*)	X32 (connectors)
68	PCM	Crimp:RG174/vert.	(1*)	X23 (connectors)
69	TEMP	Crimp:RG174/vert.	(1*)	X24 (connectors)
70	TPD_INPUT	Crimp:RG174/vert.	(1*)	X15 (connectors)
71	[undefined]	Backplane:96-pin/ABC	(2*)	X6,X7 (connectors)
72		Crimp:RG174/vert.	(1*)	X20 (connectors)
73		D-SUB:37-pin/US/female	(1*)	X18 (connectors)
74		IDC:16-pin/ribbon	(1*)	X29 (connectors)
75		Testpin:0.8mm/ceramic	(10*)	X1,X5,X10,X11,X14,X19,X21,X25,X26,X28 (connectors)
76				

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). Names of components with undefined values are shown in **red**. Additional information can possibly be found directly in the schematics.

- 1 EAGLE Version 5.11.0 Copyright (c) 1988-2010 CadSoft
- 2 Schematics part list of 'ttfssfieldbox2.sch'
- 3 Exported at 2011-02-28 15:24

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	2.2u	CE-TANTAL:0.2"	CE02D	T 1
9	C2	1u	C-0.1"	C01N	T 4
10	C3	2.2u	CE-TANTAL:0.2"	CE02D	T 1
11	C4	100n	C-0.1"	C01N	T 4
12	C5	[undefined]	C-0.1"	C01N	T 5
13	C6	22u	CE-TANTAL:0.2"	CE02D	T 1
14	C7	22u	CE-TANTAL:0.2"	CE02D	T 1
15	C8	1n	C-0.1"	C01N	T 1
16	C9	1n	C-0.1"	C01N	T 1
17	C10	[undefined]	C-0.1"	C01N	T 6
18	C11	[undefined]	C-0.1"	C01N	T 5
19	C12	1u	C-0.1"	C01N	T 4
20	C13	100n	C-0.1"	C01N	T 4
21	C14	22u	CE-TANTAL:0.2"	CE02D	T 1
22	C15	100n	C-0.1"	C01N	T 4
23	C16	1n	C-SMD:0805	CS	B 1
24	C17	100n	C-0.1"	C01N	T 4
25	C18	1n	C-SMD:0805	CS	B 1
26	C19	[undefined]	C-0.1"	C01N	T 4
27	C20	22u	CE-TANTAL:0.2"	CE02D	T 1
28	C21	[undefined]	C-0.1"	C01N	T 4
29	C22	22u	CE-TANTAL:0.2"	CE02D	T 1
30	C23	22u	CE-TANTAL:0.2"	CE02D	T 1
31	C24	1n	C-0.1"	C01N	T 1
32	C25	[undefined]	C-0.1"	C01N	T 4
33	C26	1n	C-0.1"	C01N	T 1
34	C27	100n	C-0.1"	C01N	T 3
35	C28	100n	C-0.1"	C01N	T 3
36	C29	[undefined]	C-0.1"	C01N	T 6
37	C30	100n	C-0.1"	C01N	T 5
38	C31	100n	C-0.1"	C01N	T 5
39	C32	[undefined]	C-0.1"	C01N	T 5
40	C33	[undefined]	C-0.1"	C01N	T 5
41	C34	100n	C-0.1"	C01N	T 4
42	C35	100n	C-0.1"	C01N	T 4
43	C36	100n	C-0.1"	C01N	T 5
44	C37	100n	C-0.1"	C01N	T 5
45	C38	100n	C-0.1"	C01N	T 4
46	C39	[undefined]	C-0.1"	C01N	T 6
47	C40	[undefined]	C-0.1"	C01N	T 4
48	C41	100n	C-0.1"	C01N	T 4
49	C42	100n	C-0.1"	C01N	T 4
50	C43	[undefined]	C-0.1"	C01N	T 6
51	C44	100n	C-0.1"	C01N	T 4
52	C45	100n	C-0.1"	C01N	T 4
53	C46	100n	C-0.1"	C01N	T 4
54	C47	[undefined]	C-0.1"	C01N	T 4
55	C48	[undefined]	C-0.1"	C01N	T 4
56	C49	100n	C-0.1"	C01N	T 5
57	C50	100n	C-0.1"	C01N	T 5
58	C51	100n	C-0.1"	C01N	T 5
59	C52	100n	C-0.1"	C01N	T 5
60	C54	100n	C-0.1"	C01N	T 4
61	C55	100n	C-0.1"	C01N	T 4
62					

63	---	D---				
64	D1	[undefined]	D-SMD:MiniMELF	DS	T	3
65	D2	[undefined]	D-SMD:MiniMELF	DS	T	3
66	D3	[undefined]	D-SMD:MiniMELF	DS	T	3
67	D4	[undefined]	LED-3mm	DL	T	2
68	D5	15V	DZ-0.4"	DZ	T	2
69						
70	---	J---				
71	J2	[undefined]	JMP:Wire-0.1"	J01	T	2
72	J3	[undefined]	JMP:Wire-0.1"	J01	T	2
73	J6	[undefined]	JMP:Wire-0.1"	J01	T	2
74						
75	---	N---				
76	N1	HCPL2231	DIP-8	HCPL2231	T	3
77	N2	HCPL2231	DIP-8	HCPL2231	T	3
78	N4	THS4131	S0-8	THS4131	T	4
79	N5	THS4131	S0-8	THS4131	T	4
80	N6	LT1125	S016W	LT1125S	T	5
81	N7	THS4131	S0-8	THS4131	T	4,5
82	N8	7915	T0-220	79XXL	T	1
83	N9	AD620	DIP-8	AD620	T	5
84	N11	THS4131	S0-8	THS4131	T	4
85	N12	THS4131	S0-8	THS4131	T	4,6
86	N13	AD620	DIP-8	AD620	T	5,6
87	N14	THS4131	S0-8	THS4131	T	4,6
88	N15	AD620	DIP-8	AD620	T	5,6
89	N19	THS4131	S0-8	THS4131	T	4
90	N25	7805	T0-220	78XXL	T	1
91	N27	7815	T0-220	78XXL	T	1
92						
93	---	R---				
94	R1	5k9	R-0.4"	R	T	3
95	R2	5k9	R-0.1"	R01N	T	3
96	R3	5k9	R-0.1"	R01N	T	3
97	R4	147	R-0.1"	R01N	T	4
98	R5	147	R-0.1"	R01N	T	4
99	R6	10k	R-0.1"	R01N	T	4
100	R7	100	R-0.1"	R01N	T	6
101	R8	100	R-0.1"	R01N	T	6
102	R9	4k99	R-0.1"	R01N	T	6
103	R10	10K	R-0.1"	R01N	T	6
104	R11	100	R-0.1"	R01N	T	5
105	R12	100	R-0.4"	R04N	T	5
106	R13	10K	R-0.1"	R01N	T	5
107	R14	10K	R-0.1"	R01N	T	5
108	R15	10K	R-0.4"	R04N	T	5
109	R16	10K	R-0.1"	R01N	T	5
110	R17	10k	R-0.1"	R01N	T	5
111	R18	10k	R-0.1"	R01N	T	5
112	R19	*	R-0.1"	R01N	T	5
113	R20	10k	R-0.1"	R01N	T	5
114	R21	100	R-0.1"	R01N	T	5
115	R22	100	R-0.1"	R01N	T	5
116	R23	10K	R-0.1"	R01N	T	6
117	R24	10k	R-0.1"	R01N	T	4
118	R25	4k64	R-0.4"	R	T	4
119	R26	4k64	R-0.4"	R	T	4
120	R27	1k	R-0.4"	R	T	4
121	R28	100	R-0.1"	R01N	T	4

122	R29	100	R-0.1"	R01N	T	4
123	R30	4k99	R-0.1"	R01N	T	6
124	R31	750	R-0.4"	R	T	2
125	R32	1M	R-SMD:1206	RS	B	5
126	R33	1M	R-SMD:1206	RS	B	5
127	R34	10K	R-0.1"	R01N	T	4
128	R35	10K	R-0.1"	R01N	T	4
129	R36	*	R-0.1"	R01N	T	6
130	R38	100	R-0.1"	R01N	T	4
131	R40	100	R-0.1"	R01	T	4
132	R41	10K	R-0.1"	R01	T	4
133	R42	10K	R-0.1"	R01	T	4
134	R43	10K	R-0.1"	R01	T	4
135	R44	10K	R-0.1"	R01	T	4
136	R45	10K	R-0.1"	R01N	T	4
137	R46	10K	R-0.1"	R01N	T	4
138	R48	100	R-0.1"	R01N	T	6
139	R49	100	R-0.1"	R01N	T	4
140	R50	100	R-0.1"	R01N	T	4
141	R51	100	R-0.1"	R01N	T	4
142	R52	100	R-0.1"	R01N	T	4
143	R54	100	R-0.1"	R01N	T	6
144	R55	4k99	R-0.1"	R01N	T	6
145	R56	10K	R-0.1"	R01N	T	6
146	R59	10K	R-0.1"	R01N	T	6
147	R60	4k99	R-0.1"	R01N	T	6
148	R61	*	R-0.1"	R01N	T	6
149	R99	10K	R-0.1"	R01N	T	4
150	R100	10K	R-0.1"	R01N	T	4
151	R101	10K	R-0.1"	R01N	T	4
152	R102	10K	R-0.1"	R01N	T	4
153						
154	---	X---				
155	X1	[undefined]	Testpin:0.8mm/ceramic	XP	T	2
156	X2	GND	Testpin:0.8mm/ceramic	XT	T	1
157	X3	GD	Testpin:0.8mm/ceramic	XT	T	1
158	X4	+5V	Testpin:0.8mm/ceramic	XT	T	1
159	X5	[undefined]	Testpin:0.8mm/ceramic	XP	T	2
160	X6	[undefined]	Backplane:96-pin/ABC	XB96	T	1
161	X7	[undefined]	Backplane:96-pin/ABC	XB96	T	1
162	X8	+15V	Testpin:0.8mm/ceramic	XT	T	1
163	X9	GND	Testpin:0.8mm/ceramic	XTN	T	1
164	X10	[undefined]	Testpin:0.8mm/ceramic	XP	T	1
165	X11	[undefined]	Testpin:0.8mm/ceramic	XP	T	1
166	X12	-15V	Testpin:0.8mm/ceramic	XTN	T	1
167	X13	IN1_INPUT	Crimp:RG174/vert.	XC	T	4
168	X14	[undefined]	Testpin:0.8mm/ceramic	XP	T	1
169	X15	TPD_INPUT	Crimp:RG174/vert.	XC	T	5
170	X16	FASTM	Crimp:RG174/vert.	XC	T	6
171	X17	OUT1	D-SUB:9-pin/US/female	X09-2S-DSUBFEMALE-US	T	2
172	X18	[undefined]	D-SUB:37-pin/US/female	X37-2S-DSUBFEMALE-US	T	2
173	X19	[undefined]	Testpin:0.8mm/ceramic	XP	T	1
174	X20	[undefined]	Crimp:RG174/vert.	XS01-2S	T	4
175	X21	[undefined]	Testpin:0.8mm/ceramic	XP	T	2
176	X22	MIXR(IN2)	Crimp:RG174/vert.	XC	T	5
177	X23	PCM	Crimp:RG174/vert.	XC	T	6
178	X24	TEMP	Crimp:RG174/vert.	XS01-2S	T	4
179	X25	[undefined]	Testpin:0.8mm/ceramic	XT	T	2
180	X26	[undefined]	Testpin:0.8mm/ceramic	XT	T	2

181	<u>X28</u>	[undefined]	Testpin:0.8mm/ceramic	XP	T	2
182	<u>X29</u>	[undefined]	IDC:16-pin/ribbon	X15-DSUBRIBBON	T	2
183	X30	IN1	D-SUB:9-pin/US/male	X09-2S-DSUBMALE-US	T	2
184	X31	IN2	IDC:10-pin/vert.	X09-DSUBIDC	T	2
185	X32	OUT2	IDC:10-pin/vert.	X09-DSUBIDC	T	2