

BOM for one half bridge SystemD_2k4 V1.5 by ChocoHolic, Updated Version March 22nd 2014**Safety Warning: Circuit operates at high voltages. Lethal injury possible. Only for skilled persons!****Use suitable isolated connectors for the speakers, i.e. Speakon.****Please note: This is a DIY project for advanced enthusiasts. No warranties.**

Rated power of one half bridge: 1200W into 2R

Rated power of two half bridges in bridged mode: 2400W into 4R

The project requires an advanced level of know how.

Ref	Value	Tolerance	El. min. requirements	Footprint	Type/Style	Comment
C_Add201	47p		100V		FKP, SilverMica	Any other film or foil type will work, but less premium. Solder on top of R216.
C_Add301	1uF		250V		MKS, MKP	Series connection of C_Add301 and R_Add301. Placed aside the board from output to GND.
C201	100pF		16V	8X5 RM5	MKP, FKP	Any other film or foil type will work, but less premium
C202	100pF		16V	8X5 RM5	MKP, FKP	Any other film or foil type will work, but less premium
C203	470pF		16V	SM0805	NPO / COG	X7R will work, but less premium
C204	470pF		16V	SM0805	NPO / COG	X7R will work, but less premium
C205	1uF		25V	SM0805	X7R	Anything between 100nF...1uF should work
C206	1uF		25V	SM0805	X7R	Anything between 100nF...1uF should work
C207	NIP		16V	8x7 RM5	MKP, FKP	Any other film or foil type will work, but less premium
C208	470p		16V	8x7 RM5	MKP, FKP	Any other film or foil type will work, but less premium
C209	NIP					
C210	1nF	+/- 5%	100V	8X5 RM5	MKP, FKP	Any other film or foil type will work, but less premium
C211	1nF	+/- 5%	100V	8X5 RM5	MKP, FKP	Any other film or foil type will work, but less premium
C212	4u7	+/- 5%	16V	32x16 RM27.5	MKP	Any other film or foil type will work, but less premium
C213	4u7	+/- 5%	16V	32x16 RM27.5	MKP	Any other film or foil type will work, but less premium
C214	47p	+/- 10%	16V	8X5 RM5	MKP, FKP	Any other film or foil type will work, but less premium
C215	NIP		16V	8x7 RM5	MKP, FKP	Any other film or foil type will work, but less premium
C216	47pF	+/- 10%	16V	8X5 RM5	MKP, FKP	Any other film or foil type will work, but less premium
C217	10n	+/- 5%	16V	8x7 RM5	MKP, FKP	Any other film or foil type will work, but less premium
C218	1uF		25V	SM0805	X7R	Anything between 100nF...1uF should work
C219	1uF		25V	SM0805	X7R	Anything between 100nF...1uF should work
C220	4u7	- 30% / +50%	16V	8x8 RM5	MKT	E-cap will also work, but less premium
C221	4u7	- 30% / +50%	16V	8x8 RM5	MKT	E-cap will also work, but less premium
C222	1uF		25V	SM0805	X7R	Anything between 100nF...1uF should work
C223	1uF		25V	SM0805	X7R	Anything between 100nF...1uF should work
C224	NIP		16V	SM0805	NPO / COG	X7R will work, but less premium
C301	470uF					
C302	470uF					
C303	1u		25V	SM0805	X7R	
C304	470uF					
C305	470uF					
C306	47uF	- 30% / +50%	16V	RM5	E-cap	Rect 8x8 came from MKT, now round e-cap with RM5 RM2.5 and manual preforming also possible
C307	NIP			SM0805		
C308	470uF					
C309	470uF					
C310	470p		25V	SM0805	X7R	
C311	1u		25V	SM0805	X7R	
C312	1u		25V	SM1210	X7R	Simply use 100V like C319
C313	1000uF	- 30% / +50%	25V	D11 RM7.5	- 30% / +50%	

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C314	100uF	- 30% / +50%	25V	D7 RM2.5	- 30% / +50%	
C315	1u		25V	SM0805	X7R	
C316	1u		25V	SM0805	X7R	
C317	4n7		50V	SM0805	X7R	
C318	4n7		50V	SM0805	X7R	
C319	2x 1u		100V	SM1210	X7R	Double stacked / back pack
C320	220p	+/- 10%	500V	SM1206	NPO / COG	
C321	1u		50V	SM1210	X7R	Simply use 100V like C319
C322	220p	+/- 10%	500V	SM1206	NPO / COG	
C323	2x 1u		100V	SM1210	X7R	Double stacked / back pack
C324	1u		50V	SM1210	X7R	Simply use 100V like C319
C325	2x 1u		100V	SM1210	X7R	Double stacked / back pack
C326	220p	+/- 10%	500V	SM1206	NPO / COG	
C327	0.33uF	+/-5% for the sum 1.98uF of C327+...+C332	100V	8x9 RM5	MKP	If MKP not available, check for MKT with 400V
C328	0.33uF	+/-5% for the sum 1.98uF of C327+...+C332	100V	8x9 RM5	MKP	If MKP not available, check for MKT with 400V
C329	0.33uF	+/-5% for the sum 1.98uF of C327+...+C332	100V	8x9 RM5	MKP	If MKP not available, check for MKT with 400V
C330	0.33uF	+/-5% for the sum 1.98uF of C327+...+C332	100V	8x9 RM5	MKP	If MKP not available, check for MKT with 400V
C331	0.33uF	+/-5% for the sum 1.98uF of C327+...+C332	100V	8x9 RM5	MKP	If MKP not available, check for MKT with 400V
C332	0.33uF	+/-5% for the sum 1.98uF of C327+...+C332	100V	8x9 RM5	MKP	If MKP not available, check for MKT with 400V
C333	47p		500V	SM1206	NPO / COG	
C334	47p		500V	SM1206	NPO / COG	
C335	2x 1u		100V	SM1210	X7R	Double stacked / back pack
C336	2x 1u		100V	SM1210	X7R	Double stacked / back pack
C337	2x 1u		100V	SM1210	X7R	Double stacked / back pack
C338	2x 1u		100V	SM1210	X7R	Double stacked / back pack
C339	220p	+/- 10%	500V	SM1206	NPO / COG	
C340	2x 1u		100V	SM1210	X7R	Double stacked / back pack
C341	1n		16V	SM0805	X7R	
C342	2x 1u		100V	SM1210	X7R	Double stacked / back pack
C343	1n		16V	SM0805	X7R	
C344	2x 1u		100V	SM1210	X7R	Double stacked / back pack
C401	100uF	- 30% / +50%	25V	D7 RM2.5		
C402	100uF	- 30% / +50%	25V	D7 RM2.5		
C403	1u		25V	SM0805	X7R	Anything between 100nF...1uF should work
C404	1u		25V	SM0805	X7R	Anything between 100nF...1uF should work
C405	1u		25V	SM0805	X7R	
C406	1u		25V	SM0805	X7R	
C407	1000uF	- 30% / +50%	25V	D11 RM7.5		
C408	1000uF	- 30% / +50%	25V	D11 RM7.5		
D_Add201	Z5V6		0.5W			Also 1W types or 1.3W types in DO-41 will work. Use wired type. Solder anti-series connection of D_Add201 and D_Add202 on SMD side of PCB.
D_Add202	Z5V6		0.5W			Also 1W types or 1.3W types in DO-41 will work. Use wired type. Solder anti-series connection of D_Add201 and D_Add202 on SMD side of PCB.
D201	Z39V	+/-5%	0.5W	D6_slim (DO-35)		Also 1W types or 1.3W types in DO-41 will work.
D202	Z39V	+/-5%	0.5W	D3 (DO-35)		Also 1W types or 1.3W types in DO-41 will work.
D203	BAV21			D3 (DO-35)		
D204	BAV21			D3 (DO-35)		
D205	1N4148			D3 (DO-35)		
D206	1N4148			D3 (DO-35)		

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D301	BAT42			D3 (DO-35)		
D302	Z12V	+/-5%	0.5W	D4 (DO-35)		Also 1W types or 1.3W types in DO-41 will work.
D303	BAV21			D3 (DO-35)		
D304	1N4148			D3 (DO-35)		
D305	MBR1100			D5 (DO-41)		
D306	MBR1100			D5 (DO-41)		
D307	MBR1100			D5 (DO-41)		
D308	MBR1100			D5 (DO-41)		
D309	1N4148			D3 (DO-35)		
D310	MBR60L45CTG			TO220		
D311	MBR60L45CTG			TO220		
D312	V30200C			TO220		
D313	V30200C			TO220		
D401	Z15V	+/-5%	1W or 1.3W	D4 (DO-41)		If not available, then place any Z15V you can get.
D402	Z15V	+/-5%	1W or 1.3W	D4 (DO-41)		If not available, then place any Z15V you can get.
D403	MBR1100			D5 (DO-41)		
D404	5V6	+/-5%	0.5W	D3 (DO-35)		Also 1W types or 1.3W types in DO-41 will work.
D405	5V6	+/-5%	0.5W	D3 (DO-35)		Also 1W types or 1.3W types in DO-41 will work.
D406	LED	Vf = 1.60V...1.75V, Diameter 3mm, RM 2.5, Red		LED-3mm		Red, pick type with Vf = 1.60V...1.75V
D407	LED	Vf = 1.60V...1.75V, Diameter 3mm, RM 2.5, Red		LED-3mm		Red, pick type with Vf = 1.60V...1.75V
D410	Z12V	+/-5%	0.5W	D4 (DO-35)		Also 1W types or 1.3W types in DO-41 will work.
D411	MBR1100			D5 (DO-41)		
D412	MBR1100			D5 (DO-41)		
F401	8AT			Vertical	i.e. fuse holder Buerklin.com 46G5840	Use sand filled high breaking types
F402	0.2AT			Vertical	i.e. fuse holder From Buerklin 46G5840	
F403	0.2AT			Vertical	i.e. fuse holder From Buerklin 46G5840	
F404	0.5AT			Vertical	i.e. fuse holder From Buerklin 46G5840	
F405	8AT			Vertical	i.e. fuse holder From Buerklin 46G5840	Use sand filled high breaking types
JP301	CuBar			RM 10.8		
JP302	ThermoSwitch		Normally conductive, opens at 65C	TO220		
JP303	CuBar			RM 10.8		
L301	10uH			T157-6		Verified in proto: Amidon: T157-6, 30 turns of 1.32Cul
Q201	2N5401			TO92		
Q202	2N5551			TO92		
Q203	BC550C			TO92		
Q204	BC560C			TO92		
Q205	BC560C			TO92		
Q206	BC550C			TO92		
Q301	2N5551			TO92		
Q302	AnyPWRtype		20V/5A	TO220	N Chanel Power MosFet	

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Q303	2N5551				TO92	
Q304	FZT853				SOT223	
Q305	FZT953				SOT223	150mm ² Cu-sheet Needed as heat sink
Q306	FZT853				SOT223	
Q307	FZT953				SOT223	150mm ² Cu-sheet Needed as heat sink
Q308	IRFP4668				TO247	
Q309	IRFP4668				TO247	
Q401	BD243C				TO220	Heat sink: 20K/W or less
R_Add201	4k7	+/- 2%			1206	Mount on SMD side below C208
R_Add301	1	+/-10%		50W (Option 5W)		Low inductive type. Series connection of C_Add301 and R_Add301. Placed aside the board from output to GND. 50W+ heat sink only needed for large 10kHz rectangle. For music program 5W is sufficient.
R201	5k6	+/- 2%			SM0805	Match R201&202 for high CMRR
R202	5k6	+/- 2%			SM0805	Match R201&202 for high CMRR
R203	47k	+/- 10%			SM0805	
R204	47k	+/- 10%			SM0805	
R205	18k	+/- 2%			SM0805	Match R205&206 for high CMRR
R206	18k	+/- 2%			SM0805	Match R205&206 for high CMRR
R207	2k2	+/- 2%			SM0805	
R208	2k2	+/- 2%			SM0805	
R209	47k	+/- 2%		1/4W	R5 (0207)	
R210	22k	+/- 2%		1/4W	R5 (0207)	
R211	22k	+/- 2%		1/4W	R5 (0207)	
R212	47k	+/- 2%		1/4W	R4 (0207)	
R213	10	+/- 10%			SM0805	
R214	1k	+/- 2%			SM1206	
R215	10	+/- 10%			SM0805	
R216	10k	+/- 2%		1W	R6	
R217	NIP				SM0805	
R218	1k	+/- 2%			SM0805	
R219	1k	+/- 2%			SM0805	
R220	NIP				SM0805	
R221	560	+/- 2%			SM0805	
R222	0R (Jumper)				SM0805	
R223	820	+/- 1%		1/4W	R4 (0207)	
R224	820	+/- 1%		1/4W	R4 (0207)	
R225	270	+/- 1%		1/4W	R4 (0207)	
R226	270	+/- 1%		1/4W	R4 (0207)	
R227	3k9	+/- 1%			SM0805	
R228	3k9	+/- 1%			SM0805	
R229	10	+/- 10%		1/4W	R4 (0207)	
R230	47k	+/- 1%		1/4W	R5 (0207)	
R231	470	+/- 1%			SM0805	
R232	NIP				SM0805	
R233	390	+/- 1%			SM0805	
R234	10	+/- 10%		1/4W	R4 (0207)	
R235	470	+/- 10%			SM0805	

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R236	68	+/- 1%		SM0805	
R237	68	+/- 1%		SM0805	
R238	10	+/- 10%		SM0805	
R239	10	+/- 10%		SM0805	
R301	330k	+/- 1%	1/4W	R4 (0207)	
R302	33k	+/- 1%		SM0805	
R303	10k	+/- 1%		SM0805	
R304	47	+/- 10%		SM0805	
R305	15k	+/- 2%		SM0805	
R306	47k	+/- 10%		SM0805	
R307	1k8	+/- 2%		SM0805	
R308	39k	+/- 10%	1/4W	R4 (0207)	
R309	10k	+/- 10%	1/4W	R4 (0207)	
R310	3k3	+/- 1%		SM0805	
R311	2k2	+/- 1%		SM0805	
R312	560	+/- 1%		SM0805	
R313	3k3	+/- 1%		SM0805	
R314	5k6	+/- 1%		SM0805	
R315	8k2	+/- 1%		SM0805	
R316	10	+/- 10%	1/4W	R4 (0207)	
R317	10	+/- 10%	1/4W	R4 (0207)	
R318	6R8	+/- 10%	1/4W	R4 (0207)	
R319	6R8	+/- 10%	1/4W	R4 (0207)	
R320	68	+/- 10%	1/4W	R4 (0207)	
R321	68	+/- 10%	1/4W	R4 (0207)	
R322	2R35 (2x4R7)	+/- 10%		SM1206	double stacked 4R7
R323	2R35 (2x4R7)	+/- 10%		SM1206	double stacked 4R7
R324	33k	+/- 10%	1W	R5 (0207)	
R325	100	+/- 10%	1/4W	R4 (0207)	
R326	100	+/- 10%	1/4W	R4 (0207)	
R327	8R2	+/- 5%	1/4W	R4 (0207)	
R328	8R2	+/- 5%	1/4W	R4 (0207)	
R329	8R2	+/- 5%	1/4W	R4 (0207)	
R330	8R2	+/- 5%	1/4W	R4 (0207)	
R331	10R	+/- 10%	2W	RM15	
R332	10R	+/- 10%	2W	RM15	
R333	120k	+/- 10%		SM0805	
R334	120k	+/- 10%		SM0805	
R335	120k	+/- 10%		SM0805	
R336	120k	+/- 10%		SM0805	
R337	120k	+/- 10%		SM0805	
R338	120k	+/- 10%		SM0805	
R398	1R5	+/- 10%	1W	R4 (0207)	
R399	1R5	+/- 10%	1W	R4 (0207)	
R401	1k5	+/- 10%	1/4W	R4 (0207)	
R402	1k5	+/- 10%	1/4W	R4 (0207)	
R403	390	+/- 10%	1/4W	R4 (0207)	
R404	1k65	+/- 1%		SM0805	If 1k65 not available parallel (stack) 2pcs 3k3
R405	3k3	+/- 1%		SM0805	
R406	1k65	+/- 1%		SM0805	If 1k65 not available parallel (stack) 2pcs 3k3
R407	470	+/- 10%		R4 (0207)	
R408	470	+/- 10%		R4 (0207)	
R409	3k3	+/- 1%		SM0805	

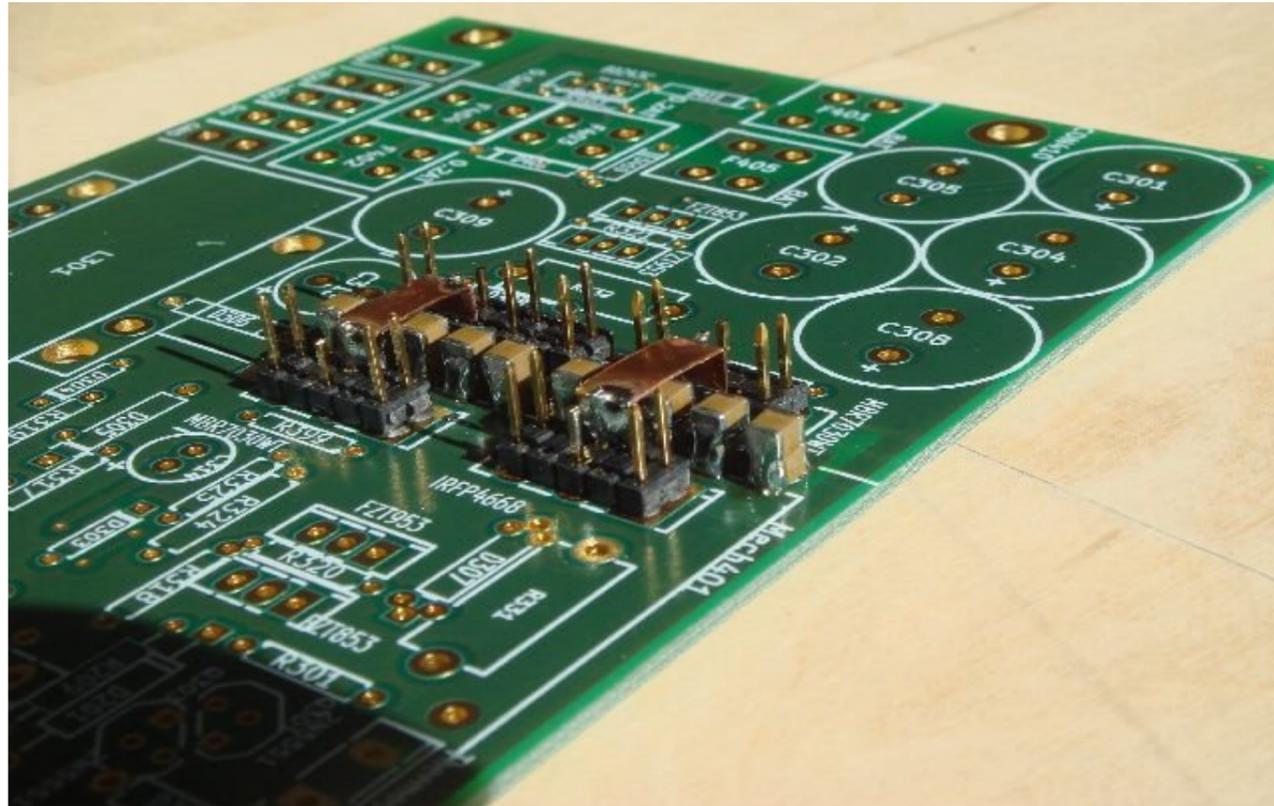
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R410	68	+/- 10%		SM0805		
R411	68	+/- 10%		SM0805		
U201	DUAL_OP			DIP8	AD8620 or LT1364	
U202	LT1016			DIP8	LT1016 or MAX913	Place only one out of U202/203/204
U203	LM306			DIP8	LM306 not tested	Place only one out of U202/203/204
U204	LM361			DIP14	LM361 not tested	Place only one out of U202/203/204
U301	IRS20957					
U401	DUAL_OP	NE5532		DIP8	NE5532	
CON301	Out-					
CON302	Out-					
CON303	Out+					
CON401	+82V					
CON402	+12V					
CON403	GND					
CON404	GND					
CON405	-12V					
CON406	Drv					
CON407	-82V					
CON408	-82V					
P201	CONN_3X2				3x2, 0.1"	
Mech401	ANGUPIE2	Aluminium, L-profile, each tail 50mm, height: 40mm				
Mech402		Aluminium, 95mmx195x1.5				
PCB	V1.0				Cu: 70um (2Oz) Double sided	35um (1Oz) possible, but close to melt down when hotrodding into 2R unbridged or 4R bridged
Misc1		Cu-Foil: 0.3mm (Cu-bars, mini heat sinks, MosFet shield, diode shield)				
Misc2		Isolation material for transistors and diodes				
Misc3		Main heat sink. Rth<1 K/W (for full power operation without fan)				
Misc4		Heat sink for Q401. Rth<20 K/W				

Pictures

CuBars, dual pin rows, X7R caps

Double stacked means, just put a second X7R cap on top of each, like a back pack.
Ensure at least 1mm distance between the CuBars and the Caps.
The dual pin rows are standard items with a 2.54mm spacing, but we need pins only every 5.08mm.
Simply pull out the pins which are not needed.



Copper piece at output caps

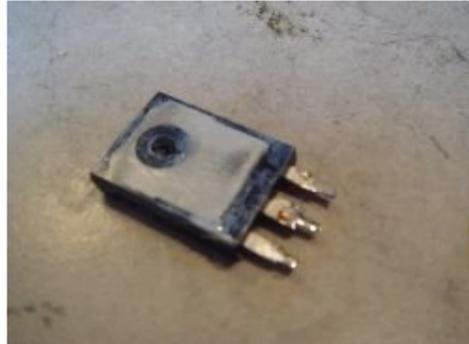
A very low inductive connection of all output caps is necessary to achieve lowest distortion.
The picture shows the L-folded and soldered copper piece with isolation.
Note: The amp also works without this. Only needed for lowest distortion.



Pictures

In order to avoid building an EMI vulcano a GND shield is necessary between the heat sinks and the following components: Q309, D311, D313
Here a picture sequence how these shields are build for TO247.

1. Q309 naked

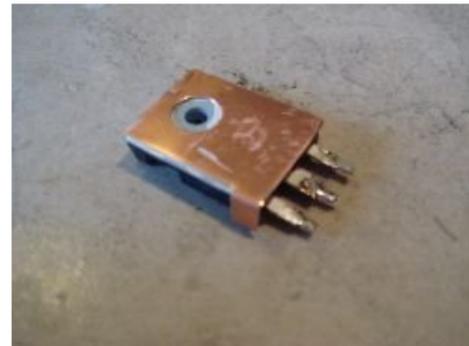


2. ..a first silicone isolator..



3. ..now the shield..

The hole in the shield must be 6mm (or 6.5mm) to ensure that the screw does not touch the copper.



4. .. the second silicone pad..

The bend corner of the copper is the solder pad of the shield.



For TO220 it is similar, but instead of a huge hole in the shield – better drill 4mm and use the screw isolators for TO3.
These isolators provide a long enough isolation through the metal of the semiconductor, silicone pad and shield.

Pictures

The shields must be connected to GND close at the switching stage.

For Q309 and D311 you can directly put a wire from the solder pad of the shield to the GND plane on the PCB.

Just scratch away some varnish from the PCB to create a solder pad on the GND plane of the PCB.

The picture is still from V1.3, while V1.5 has TO220 for D311 and D313. Also the RC towards the screw of the thermoswitch is not used in V1.5

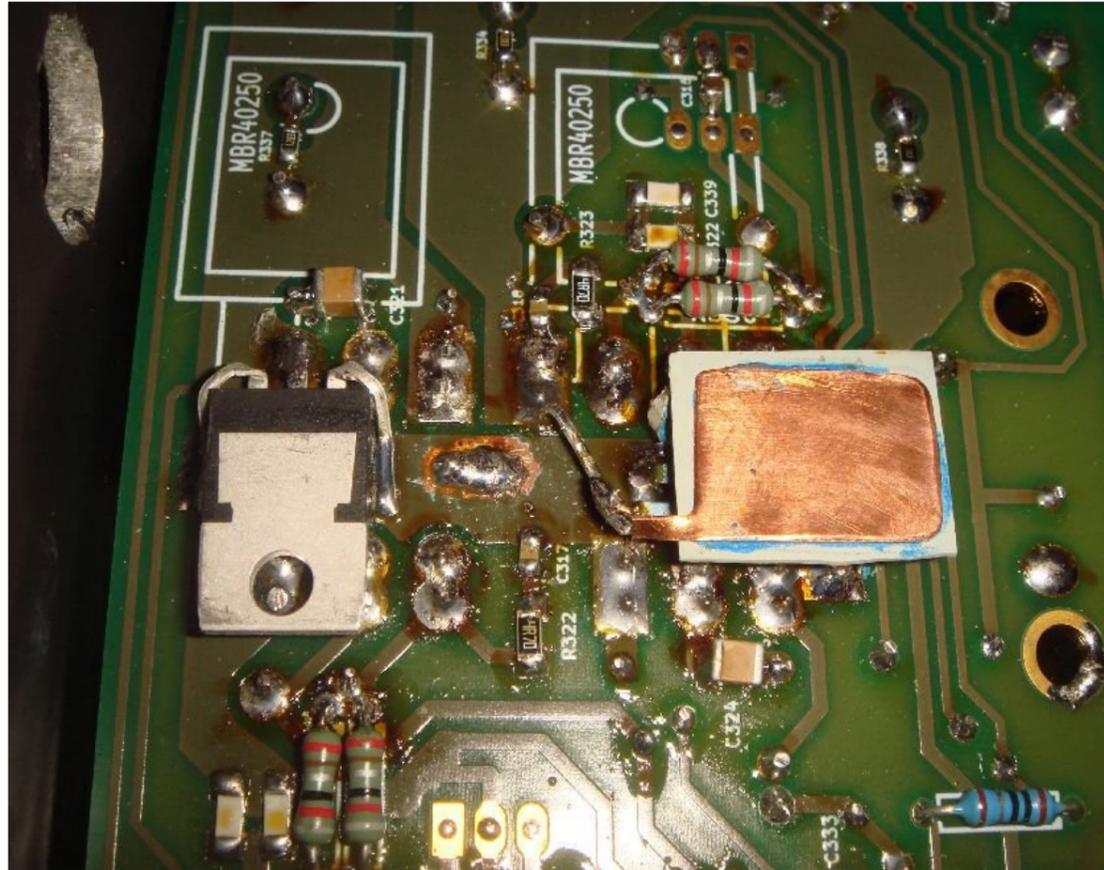


Placing D312 and D313.

Position of D312 and D313 changed vs V1dot3. No extra heat sink. Heat is transferred by thermal pads towards back cover.

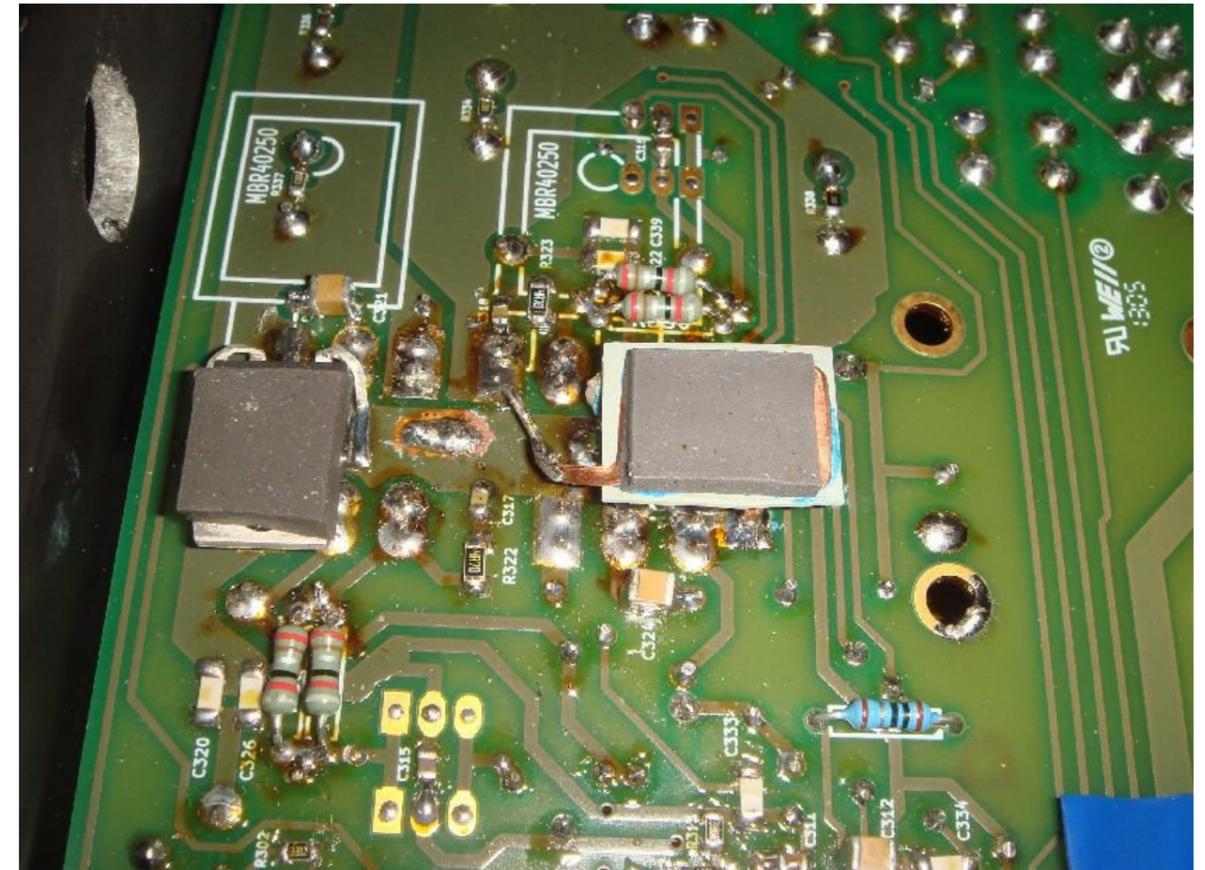
The shield does not change these connections and must be isolated from the diode!

Only D313 needs a shield. The shield is directly connected to one anode leg.



Thermal Pads for D312 and D313

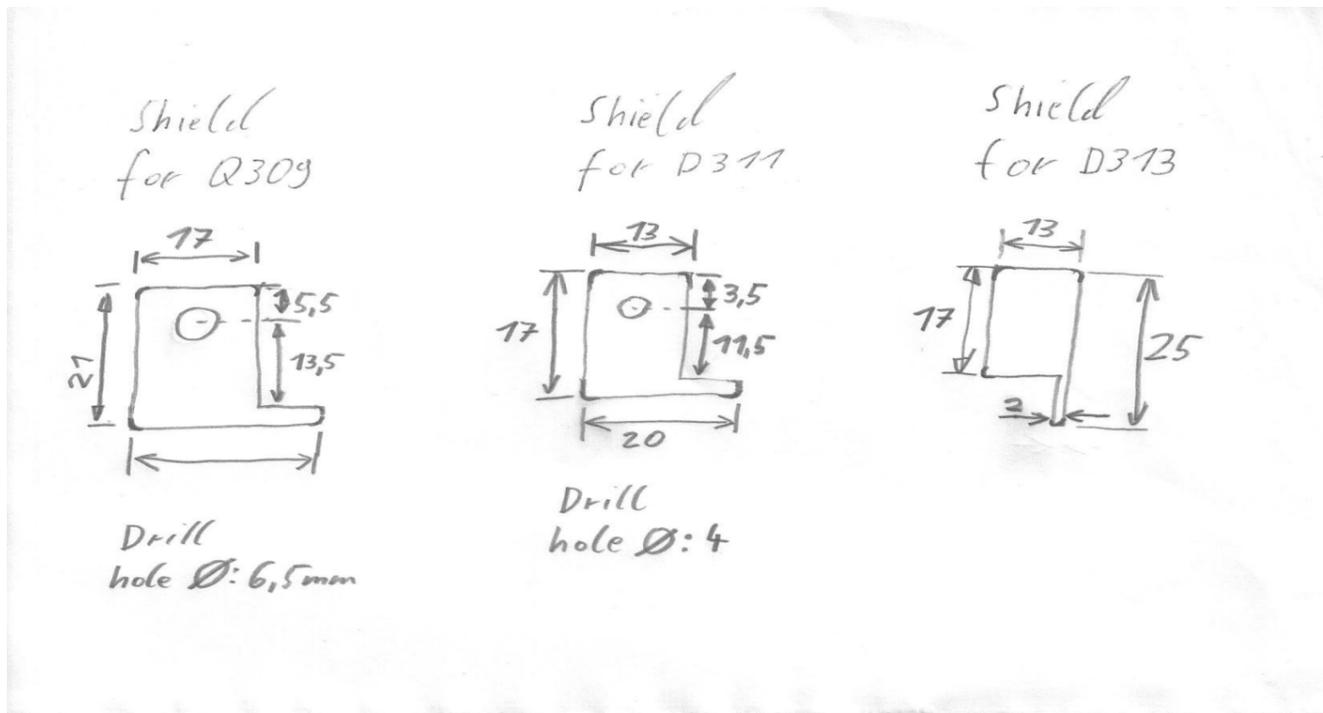
Thickness of thermal pads is 2mm for D313 and 3mm for D312.



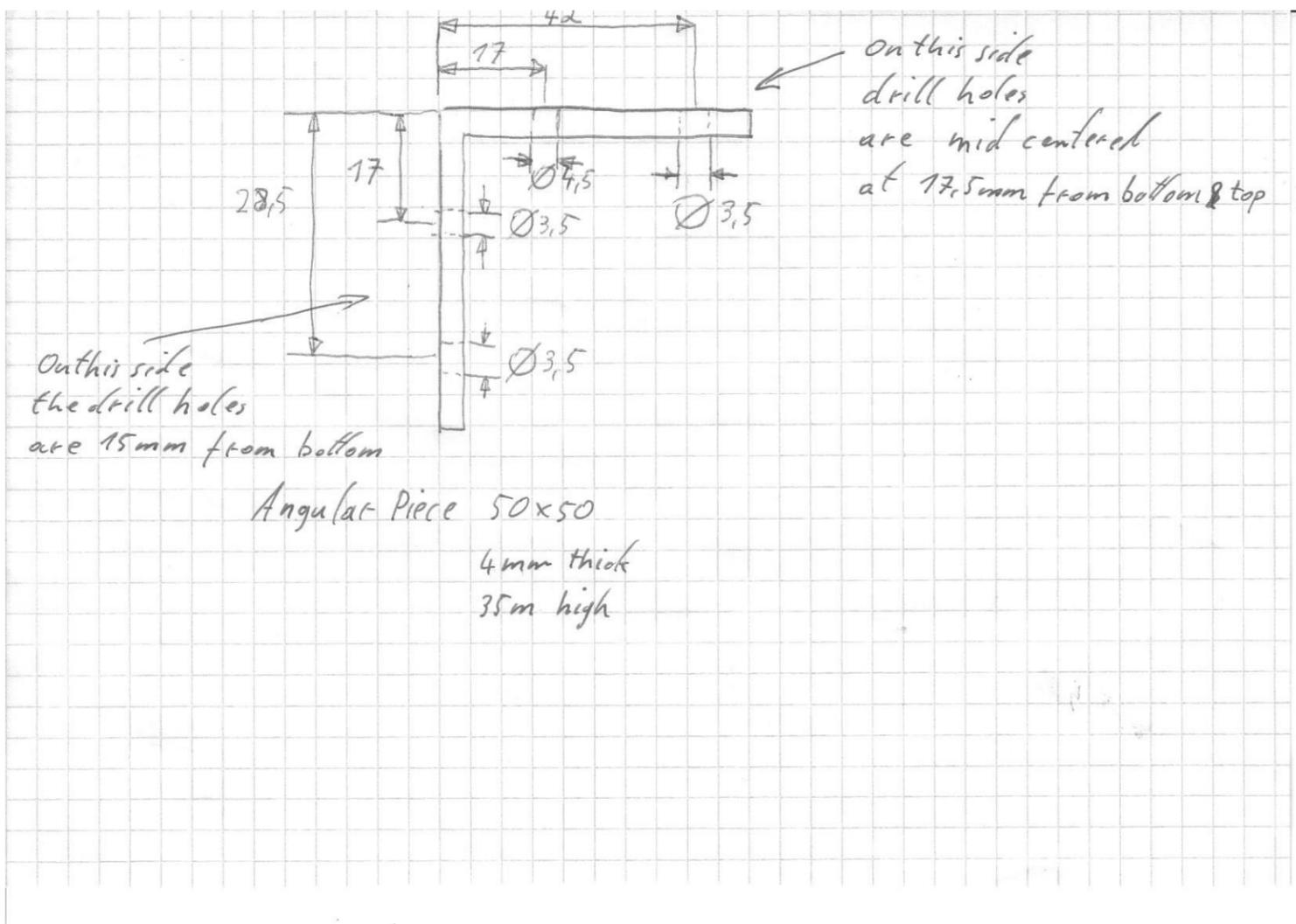
Different from V1.3 in V1.5 the metal back cover does not have cut outs but covers the entire backside and acts directly as heat sink for D312 and D313.

The back cover shall be connected to GND, i.e. through the drill hole close to L301.

Copper shields for Q309, D311 and D313



Angular Piece



**In order to get it going you will need some patience and follow the described small steps below.
Any short cut bears a high risk to fry your work.**

1. 12V operation

The circuit can operate from +/-12V with very minor preparation.

Connect a 1k8 resistor parallel to R308.

Connect a 3k3 resistor parallel to R324.

Now you can power the high power rails from +/-12V (normally +/-65V...+/-83V).

Power up the amp from +/-12V and the auxiliary Drv.

- a) Both LEDs on?
- b) +/-12V still stable?
- c) Drv vs -82V connector correct? Should be 15V...25V
- d) Are +/-1.65V OK? Should be 1.6V..1.75V.
- e) Are +/-5V OK? Should be 4.8V...5.25V.
- f) Does the amp operate properly ? Switching frequency should be 430..490kHz.

2. Limited power operation

Remove the 1k8.

Remove the 3k3.

Connect +/-82V through light bulbs. Type 220V/100W or 110V/60W.

If you cannot get light bulbs anymore then use two series resistors of 470hms / 50W

- a) Both LEDs on?
- b) Current consumption on +/-82V rails Ok? Must be below 100mA
- c) Does the amp oscillate properly ? Switching frequency should be 430..490kHz.
- d) Use test signals and load according your taste.

3. Full power operation

Connect also the +/-82V without bulbs or resistors.

- a) Both LEDs on?
- b) Current consumption on +/-82V rails Ok? Must be below 100mA
- c) Does the amp oscillate properly ? Switching frequency should be 430..490kHz.
- d) Test according your taste.
- e) Calm down your neighbours.