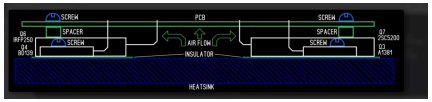
https://www.diyaudio.com/community/threads/very-simple-quasi-complimentary-mosfet-amplifier.255427/page-108#post-5439096

max. Supply Voltage is 42V DC

page 62/post 1222		
page 62/post 1222	That does not work. 4ohms driven from a 30-0-30Vac transformer will give about 100W to 120W. That would normally require a 100VA to 200VA transformer. Using a 300VA transformer to charge the smoothing capacitance will result in the capacitors recharging to very close to full voltage on every half cycle. Very small capacitors which will have a lower ripple current rating will discharge deeply on every half cycle. They will overheat pretty quickly if you try driving the amplifier very hard. You would need to use a transformer well below 100VA to reduce the ripple current on the smoothing capacitors to significantly reduce the heating effect. Just double up the output stage SOA and you get a better amplifier.	low caps with big Transformer
1227	You commonly see a small 'c' before the LC, but the LC is the driver (push the 'c' too large and it reverts to capacitor input) As Andrew pointed out you need a minimum standing (or bias) current to keep a choke input filter at 0.7 Vin for a fixed L. Otherwise it "converts" back to capacitor input (and Vout = 1.4 Vin). The "magic" is a "Swinging" choke, whose L is not fixed. The L rises as the current drops, reducing the critical current required to keep it in "Choke input" mode. The classic article is by "Cathode Ray" in Wireless World, December, 1957 **A copy is visible here** http://www.r-type.org/articles/art-144.htm	CLC, inductor
1231	DACZ Schamtic -2016	
1240	In a general sense, for power output you figure it from the peak to peak voltage at the highest output voltage. For 75V rails, and using bipolars, you should use at least four pairs of outputs. This has an advantage as the drive to the individual output devices and their emitter resistors is rather less than single very large devices, giving you more power but at a cost of mechanical and thermal complexity. For mosfet amps, you can use some of the very large mosfets available from IXYS, Vishay SGS and Fairchild. Assuming you use 1Kw mosfets in Class AB (and be aware you should water cool them!), you could expect to lose quite a bit of voltage from the rails because the Vgs of these devices is around 5V and the high current output, particularly with the 4R loads, will drop considerable voltage across the source resistors. Choose 0.33R resistors, and assuming you are running 15A through them. This is a lot of drop from gate down to output; 5V plus (15 x 0.33) a total of 10V. You must also realise that the rail voltage will sag with heavy current; maybe up to 5V as well. So, with 75V at idle you must drop 5V from the gate/source drive, then another 5V from the source resistors, and add the 5V sag of the rail. This gives you a total voltage of 60Vpeak, or 120Vpp waveform output. Now, for 8R loads, square this figure and divide by 64. This gives us 225W, maybe a litte more if you have a stiff supply, and theoretically 450W into 4R. However, with 4R I assume not the double power, but 1.8, so it would be 405W. This is a lot of audio power, and normally used in sound reinforcement situations, like large auditorium, or maybe Texas level listening rooms with 50 people! I cannot stress how difficult it is to design very large amplifiers which sound good. It is a huge problem to hold high resolution with such amplifiers.	more power ! Not with Quasi
1253	nzlowie, I have had mine running on +/- 25V rails. 22V is about the minimum.	minimum Voltage
1256	If you used an expensive CLC, a P3717-A Coilcraft and a pair of 1000uF caps at supply side and 2,200uF at amp side, we could make it almost as good as the linear supply, which used about the same capacitance. There were limitations to the smps for this capacitance; check the manufacturer. We were using inexpensive smps, around $US75 and less. The additional components increased the cost and when we looked back at the costs, the linear supply was cheaper when you used a single, economy toroid. The entire audio spectrum is affected by dirty power supply, and it really is better to consider a linear supply and minimise your parts if you can.	SMPS vs. LPS
1260	I don't understand why filtering a SMPS makes it sound "unmusical"? Could it be the SMPS then doesn't have the peak current headroom? I use the Abletec 53v SMPS on my amps like VHEX+ with two pairs of 4700uF separated by rather large two parallel 5R power resistors for a CRC between the SMPS and the amp. I also fit 330pF + 10R RF snubbers on the input to the CRC's. It sounds quite good - actually quieter than my linear supplies. I can put my ear touching the tweeter and hear literally nothing. Dynamics and "musicalty" all seems to be there.	SMPS with CRC
1265	My bad explanation. If we used good filtering, we made the smps sound very close to the linear supply; very musical, in fact. But we had to spend as much on inductors and caps to do this as we did for the linear supply; this meant that if we could get the transformer for the same or less price as the smps, it really was almost the same cost in total. My conclusion: Unless you can buy smps markedly cheaper than the transformer, AND you don't need a lot of filter networks for good sound, then you might as well use the smps, but be aware that most smps units create a lot of RFI, and this affects the regulatory (UL, CE, etc) requirements.	SMPS
1267/1268	It would be high if you expect high continuous current draw. But depending on your use, a higher R of course gives better filtering and lower ripple, which gives "blacker blacks" for music. I don't play at loud volumes continuously but like high dynamic reserve. This particular R values of 2.5ohm gives me ripple less than 1mV at the amp rail input. This setup will not work for class A as that level of current draw will appreciably sag the rail voltages. I agree with the cost/performance trade, Hugh. Yes, it only works for this particular Abletec SMPS. It's a nicely designed and made one (Denmark, I believe) and is a close out item that's $20 (free shipping). If it cost $80 - I would have gone linear with an Antek toroidal 300VA trafo and caps	SMPS vs. LPS
1272	The latest schematic posted needs to be corrected. Q3, Q4, Q6 & Q7 need to be fixed to the heatsink whereas the schematic shows Q5-Q7 heatsinked.	
1278	I can say for certain that this design works with 25V split rails because that's what I'm using! I've lost track of this thread in recent weeks; the circuit I have referenced in post #1 is not current anymore. Give me a little while to trawl through the recent posts and I will point you to the best schematic with component changes for your power supply. Thanks for everything Ranchu, no rush. I believe the latest schematic is on post no.1231 from DACZ. His schematic follows Hugh's last recommendation and is the one with the good connection for C7.	rail 25V
1280	he point I am trying to make, is that even according to the latest diagram in Post 1231, Q5 is shown as on the heatsink; this needs to be corrected and Q4 should be instead shown as on the heatsink.	
1281	I thought DACZ did a great job on this! Let us assume that **Q5 and the two output devices, Q6 and Q7 are all on a heatsink, and that Q4 the Vbe multiplier should be thermally mounted to either Q6 or Q7.** All the pinouts look terrific too, one of the nicest schemats I have ever seen!	
1284	I would use this schematic **as-is on 25V rails.** You might reduce the VAS bootstrap resistors, R12 and R15 to, say, 1k8 and 1k2, respectively, in order to bring the standing current back up a little, but that is of relatively minor concern. I think somewhere along the line the input transistor (Q1) was changed from a KSA992 to a 2N5401. It doesn't really matter which device you use, so long as you recognise that the pinouts are different. I would choose whatever device the board you are using has been designed for. **I guess my only quibble is that the VAS bootstrap cap (C6) is a little too small for good LF distortion, particularly if you reduce the bootstrap resistors as suggested above. You really don't need a 63V part if you are running 25V rails, so my advice is to substitute the biggest 35V that will fit on the board - but no more than 470uF.** You really should make every effort to source the A1381 for Q3.	rail 25V
1285	**With 42V rails Q3 should be mounted on its own small heatsink.** At lesser voltages this is not required. The phase inverter does not require heat sinking.	42V rail
1285	At 42V rails, the dissipation on the Q3 KSA1381 (the buffer) is 395mW and Q5 KSA1381 (the inverter) is 243mW at idle and probably less even in full output. This is thermally fine for a TO126 sitting alone on a pcb with good ventilation but no heatsinks. You could use a small flag heatsink (32C/watt) for Q3, but not for Q5. This would have been identified if there had been a problem; the entire active chain was considered when during LTSpice analysis was done and then by Ranchu when he used his Quasi in a sub-tropical city, **Brisbane, where any thermal issues would be been clearly evident months back.** **So, be assured, this is a highly evolved, refined, tested design and both Q3 and Q5 may be left free standing, with no heatsinking.** **I commend this amp to you. The sound is very good, almost tubey; the harmonic profile is very musical.** At any rail less than 42V the thermal issues relax even more. You can be sure!	AKSA

1286	Good to know it should work as is on 25v rails. I will try it out and see how it sounds. I now have several bags of KSA1381 (great transistor so don't want to run out again). Wondering if I should swap out the MJE350's that is currently there?	
1297	Q4 can be mounted direct to heatsink or coupled to Q6 and use the mounting hole of Q4 for the wiring. Q3 can be mounted also direct to heatsink or free standing on PCB and provide a separate clip-on heatsink. - 2016_09_22	DACZ Layout
1309	mounting spaciners	Q4 mounting
1310	I would put a wider spacer to insure mechanical strength, I prefer the diagram on post 409 although the above provide a better airflow.	Q4 mounting
1322/page67	The SD1047 is Elvees one of Favorite Transistors build in his "Little cheap Circlophone" Could this be a good place to use them?	BJT
1328	I just got a 5 pair pack of Onsemi NJW0281G/NJW0231G. The NJW0281G might be a good substitute for the 2SC5200.	
1331	As most realise now it's very easy to find h**igh power nmos with 300+ W ratings,** but it's more difficult to get them in npn devices. **The one that comes to mind is the 2SC3264 Sanken, there is an ON Semi 2N3668 (200W, 25A, 150V, but TO204AA, and finally a (Toshiba?)MT200 but in s**ix pages of trawling through Google I find very little of them and the 175W+ devices are expensive. It rather looks like you have to use a matched pair of npn to move up to a 100W plus quasi, **but then, it would be an interesting amp with a large nmos and two matched npns for a single output stage, so the novelty might attract some to build it out!**	BJT
1332	Hugh could you provide a shematic with this configuation (high power nmos and matched npn.....i have some good matched **MJL3281**)...	BJT
1334	BIG Quasi This is a quick and dirty Spice schematic, so this is not built. (Some of the dissipations and currents/voltages on this schematic are not correct as they relate to the 42V rails, which I analysed very carefully but NOT this version). But I have no reason to think it would not work well as I did something like this five years ago! I have used an **IRF90N20D** here; the profile of the harmonic is very much driven by the choice of the mosfet. I would use a **FQA69N25** Fairchild here, but don't have the model. Results are very good, and if you use **C5200** (not fakes!) I would expect you could increase the rails to around 56V, no higher. I have some concerns about stability at the clip on the negative waveform. This would come back to the B/C cap on the inverter, which should be a 4A device like the 2SA1837. By using a 0.33R emitter resistor matched npns is not too critical, but it does help. This is a schemat, Marc, and would need some proto work, but it would be practical. Harmonic Profile is excellent, better than the single npn version. Moreover, the mosfet NEVER turns off; at clip it's still passing more than 7mA.	**Big Quasi**
1338	I would not change either of them on Prasi's layout. It is fine as it stands. I include them on this higher power amp because I found issues with stability at negative waveform near clip (46Vpeak). You often find that more powerful amps need additional stability because their slew rate has to be higher.	Big Quasi -Stability
1345	Largest Mosfets	
1347	Farjon Quasi, Gerber with 90x90mm	
1354	DACZ gerber, schematic..etc..20160922	
1359	have found that the larger electro does not improve bass. 100uF is just fine..... **and you can use small ones with high ripple factor, 100KHz rating and 63VW** for low cost. Generally, I use Nichicon, but in N America the biggy is CDE.	C6
1369	I am running mine at 25v rails right now and the biggest thing I notice is a whole lot less heat generated! Even at 180mA bias, the quiescent heat output is under 9w so the heatsink is staying pretty cool. This also means it can work real well with two 24v SMPS bricks in series. My 25v rail supply consists of a 400VA Antek toroid and CRC consisting of 33mF qnty 4 x 0.47R in parallel and 33mF caps. The ripple at the power supply is only 7mV with 180mA bias. Speakers are dead quiet with no signal. Question for Hugh: is there any advantage in running this amp in Class A at say 1.3 amps bias? Can it even handle it assuming adequate heat removal via heatsink and PSU is designed for large continuous current? 65w of heat generated could easily be removed with fan on the heatsink,.	25-v rail
1374	Very nice pcb, beautifully laid out - my thanks! One suggestion; if you put the large outputs central on the pcb, you can fit the pcb exactly midpoint along the heatsink. The amp looks a bit more tidy but it's not essential and certainly does not change the operation. I am with Ranchu, his suggestions are my suggestions too! I generally like to use a film cap for C1, 1.5uF is just fine. Electrolytics are not quite as good, even when they are polarised by a couple of volts like this amp input stage. If you use 42V rails, 50VW caps are right on the limit (80%) so there is good sense on using 63VW as they are not much bigger and then offer a lot of upside to the rail voltage. Since outputs can just support up to 48V rails, this makes sense. **As for Class A, I do not like the idea much. I think the sound would be different, but consider that since the upper nmos does not turn off and therefore the cross over point is somewhat blurred, I cannot see the advantage in ensuring the lower npn never turns off. To achieve this, the currents would be horrific; to prevent the npn turn off at higher output (no higher than 65W into 8R, 32.3Vpeak) the quiescent current with 42V rails (no sag at all BTW) we have to give a quiescent current of 4.5A. This mandates 182W dissipation in the nmos, and 180W dissipation in the C5200. These are impossible to sustain; you'd need at least of 480W dissipation in EACH of the two output devices to maintain this dissipation over decent a lifespan for the amp. Even at 65W I see the H5 harmonic at -96dB, compared to the quiescent at 120mA where it's -84dB.** **Essentially, this amp is optimised for Class AB, and if you use to Class A, you need a different topology, more like the JLH, which is actually designed for Class A (but gets VERY hot for low output!). High dissipation in output devices reduces MTBF; effectively an increase of 11C halves the life. So if the device operates at 58C, say 33C more than 25C, the life will be almost 2exp3 less, which is 8 times. This is pretty steep, so you have to be careful.**	25-v rail
1381/page70	https://www.diyaudio.com/community/threads/very-simple-quasi-complimentary-mosfet-amplifier.255427/page-70	
1383	C6 is feeding into 2k2 and 1k2. That's an effective impedance of ~776ohms. Using a 220uF gets to a 170millisecond RC for well extended low bass response. 100uF gives only 78ms and will affect the low bass slightly, if this is inside the passband given by the input filters.	
1386	I have heard it, and so has Christian, and our belief is that there is no enhancement of the bass response with C6 at 220uF over 100uF. Had it improved, we would has suggested it, but there is no improvement, which is actually very good subjectively. Even profiling the response on LTSpice or actual measurement does not show up bigger bass response at 15Hz. There is the issue of the speaker, too, and maybe most speakers are not working too well at 15Hz. On LTSpice is see 1dB down at 13Hz with 220uF, and at 16Hz with 100uF. You cannot hear this at all; it should be up to 2dB and only then at source material with these very low frequencies. Ergo: 100uF is adequate for all use with commonly used speakers. 220uF is larger, and does not improve things, so best to use 100uF which is quite small. Very similar issues concerned the shunt fb cap too, which we agreed does not improve beyond 1000uF.	C6 bigger?
1400	**It has been determined that C8 is unnecessary provided the recommended transistors are used in in conjunction with the board layouts developed and tested thus far.**	C8...unused
1402	Unkle phunk layout	
1410	Check the PSRR. It's much poorer on the negative rail. If you add a cap multiplier to the -ve rail the PSRR improves dramatically. I used B2Spice. From -35 dB to about -89 dB (with cap multiplier) at 1Khz. Quite good all the way down to 20Hz. I'm building one and will check if this difference can make a significant difference in sound.	cap X
1411	Hi Hugh, a question's been bugging me, should the amp be supplied with a cap multiplier ? after reading Ashok's comment, i thought i should post here... I do have a pair of Mr. Evil/PMI/Jason's nice CM-PSU PCB's thats eagerly awaiting some solder job.... http://www.diyaudio.com/forums/powe...lified-mrevil-pmi-capacitance-multiplier.html .	https://www.diyaudio.com/community/threads/simplified-mrevil-pmi-capacitance-multiplier.241263/



1412	Prasi, I have never used cap multipliers with AB amps because: 1. Hum and noise is most evident with AB amps at very low signal when the amp is not working hard so even minimum filter capacitance is very effective at removing hum. These systems work best for Class A amplifiers. 2. Most cap multipliers use a resistive network to drive the gate/base. This does not reference the output voltage to a reference (like 36V from a 42V supply using a zener of voltage reference). This means that at high current the raw supply drops, and so does the 'regulated' figure moves down as a ratio, and the capacitor is modified by using the transfer function (and the series impedance) of the mosfet/bipolar, overlaying an active element in the waveform which is subtly different to a simple passive cap bank. 3. The best regulating systems use a fixed reference and to accommodate rises and falls of mains voltage you would use at least a drop of 15%. For a 42V regulation, you'd need 50V at the bridge at the input of the regulator, and this mandates a loss of headroom and efficiency, not to mention the heat dissipated by the active device! 4. More active devices in the supply rail increase unreliability and add cost, particularly since the actives must be at least as fast as the output devices! Even on my Class A circuits, I use expensive CLC passive filters. You can spend a lot of money on an inductor, certainly, but they very rarely fail and the way they remove artefacts from the supply, which are common as the harmonics of the mains frequency and switching issues from upstream, are outstanding. 5. My AB power supplies use CRC passive filters. They are very effective but the additional caps can be reduced. I also like to use this approach because the first cap sits on the bridge, removing most of the hum, while the second sits at the amplifier, giving a low impedance earth path for the speaker under drive. This confines the earth path from hum reduction device; the resistor is only small, maybe 0.15R, but it means the very high current rectifier pulses are confined to the first cap, not the second.	no CapX at AB amps_AKSA
1413	I'm not a huge fan of cap multipliers driven from main rails feed the front-end circuitry. Most schemes introduce only a small drop in the order perhaps 1-2V to keep headroom losses to a minimum. Much more than that and the amplifier's maximum power output will be severely curtailed, and we want as much headroom as we can get to deal with transients in the music. **The problems begin when the input voltage falls below the voltage at the base of the pass transistor, because hash will shoot straight through unfiltered!** Clearly we don't ever want this to happen but the prevention is to increase the Vdrop to deal with the peak ripple in the PSU under load, transient mains low-line, etc. With a typical 'compliant' PSU feeding the multiplier, that required voltage drop becomes substantial the headroom loss enormous! One also quickly realises that having gone to that extent, it is logical to to turn that cap multiplier into a series regulator and achieve "rock solid" regulation. I think there is some merit in regulated boosted rails to feed the front-end, when separate transformer windings are specified so that there is no loss of headroom. But it is hard to justify the extra cost and complexity. The simple expedient to improve negative rail PSSR is a simple RC filter. I normally use a 10R resistor (to minimise losses) against a large cap about 1000uF. It won't be as effective as a regulator, granted, but it does provide a useful improvement with minimal cost/complexity.	cap X
1414	I design my Capacitance **Multiplier using BJT (all of them). Voltage drop minimum must be 4V to avoid saturation condition.** It was used in LM3886 amplifier and won chip amplifier blind test competition. Some of contestants use expensive parts (boutique parts), but my capacitance multiplier using generic parts and the LM3886 amp. using several expensive parts (not so expensive).	cap X
1416	**The cap multiplier I was talking about is in the negative rail and only feeding the input stage from Q1 up to the VAS. Not for the complete -ve rail.** Yes it will loose a bit of voltage across it . As long as you play at normal levels this isn't a problem. If this is to be implemented for full clipping at the output, then you need a separate negative rail for this stage. That can come from a separate tapping on the transformer or a voltage multiplier on the transformer with following regulation. While you get less unclipped power output with say a loss of 2 volts or so due to this cap multiplier/or regulator , the loss will hardly be noticeable when you play music. What could be an issue if at all, is if you blast the amp wide open and keep clipping the output often , when the clipped behaviour would have to be looked at. I have not done that as yet. I'll attach the PSRR graph for the two supplies with three options. Normal rails. RC filter on the -ve rail and cap multiplier on the -ve rail. Meantime I'll also check on what happens at clipping ! Just for clarity, there is no cap multiplier or regulator on the main power supply rails.	cap X for Front end and VAS
1419	Ashok, I think we are all discussing the scenario where the cap multiplier feeds the front-end only. You may never have a problem at that 2V drop if the main rails are stiff enough (i.e. decent sized traffo, lots of capacitance, mains voltage doesn't fluctuate too much). But if you crank up the volume and there is enough ripple that the input voltage drops below the output, then the hum/buzz will shoot straight through the multiplier into the input stage, just as it would with a normal regulator. Edit: Cap multipliers look very attractive in simulation when fed from perfect voltage sources. If you simulate with a realistic amount of supply line ripple and output load then the situation often isn't so rosy. Edit2: bimo, 4V is a fair loss of headroom, especially in the -ve rail, which usually clips first!	capX
1420	If you need 25V PSU, then minimum input voltage for capacitance multiplier is 29V. If you use mosfet for pass current, the voltage drop can be lower because usually mosfet saturation volage much lower than BJT. I use capacitance multiplier for all amplifier, not only for VAS and input stage. But sometime, I use simple capacitance multiplier for VAS and input stage. Add capacitance multiplier (not a simple one, much better PSRR) again for all stage still increase sound quality.	capX
1438	For the reasons that Hugh gave, a cap multiplier is probably not needed but it did seem to help your class AB amp sound better. For class A it's a different story as the power supply is half the amp. Having as clean a supply as possible makes a difference as bias current ripple translates directly to hum in the output on a class A. I just built a simple cap multiplier following Juma's design for my little 2SK2013/2SJ313 F5 amp. It is so simple, just a few caps and resistors, a MOSFET and bam! it literally smashes the ripple to zero. This one uses a 4700uF cap, 220uF cap, 1uF film, 3 resistors, a 1N400X diode, and an IRFP240/9240. For a 22.5v rail, I got the ripple down from 20mV to under 1mV (shows 0mV on my Fluke DMM). I am tempted to try it with my class AB amp just to see what happens. I made it P2P right on top of the MOSFET legs but a simple PCB might be useful as we would be using these all the time. It doesn't put out much heat that maybe including it onto future amp designs might even be possible. Here is the schematic, I built the section after the 47,000uF cap on the heatsink. I am actually using a 33,000uF//0.125R//33,000uF CRC prior to the cap multiplier. Just make sure your caps are rated for the voltages, the multiplier will cause a voltage dropout of a few volts - so you do lose headroom. But if no PSU hum is your goal and lower level volumes is what you like, or have high sensitivity speakers like horns, this may be the ticket.	jumas CAPX
1451	Almost done with new Dacz board. I made a few minor substitutions like 0.22R source/collector resistors and used SMT 100nF bypass caps on underside. A**lso 22pF NP0 SMT instead of 30pF mica. Using NJW output rather than 2SC5200.** Still needs the output inductor to be rolled. It's a nice board and easily soldered with enough clearance in most places. Am I going to run into any issues with a 500R trimpot for setting offset vs spec'd 200R?	DACZ pcb
1454	I just fired it up and the bias pot and DC offset pot all work well. Able to get steady **100mA bias and 2 or 3mV offse**t. I must have a resistor off somewhere because sound is not loud. The gain is way low. On base of BJT output calls for 2R2 which I don't have so I put a 10R there. Wonder if that could be throwing it off? No magic smoke or anything at least and it trims nicely though.	100mA bias
1458	The Dacz boards are both completed and tested. Setup was smooth and easy on both. An excellent board that is easy to build. **At 100mA bias (35v rails),** I do not need a fan for the little Pentium heatsink that I am using. Very compact hifi setup. Sounds fantastic - long term listening and some speaker measurements next and I will report back with overall impressions. I am using higher quality components so I expect the sound should be better - but you never know. These are also the Onsemi NJW0281G NPN outputs. Seems to be working very well though. Absolutely a frustration free build and startup. The bugs on this can be definitively said to be "all worked out". Anyone should be able to take these Gerbers and BOM and have a good time now. :)	DACZ pcb
1471	This discussion about the negative rail had me thinking, because I could have sworn that on my prototype I had a simple RC filter on the IP stage to improve the situation. I looked back into my files for "CSH2" (my original codename for this project) and sure enough it is there... The boards I had manufactured a couple years ago were based off this schematic, and even though I've had to butcher these boards a little along the way to keep up with the changes, that RC filter on the -ve rail has been there the whole time! So I'm not sure when that filter was dropped from the schematic and why (I can hardly keep track of this thread either!) but I'll do some listening tests over the next few days to find out whether it sounds better with or without - all this time I have been listening to it *with* that RC filter.	RC filter at -Ve rail
1474	I'd tried this some years back and found, on balance, that it was better to have the VAS directly referenced to the negative rail when driving complementary outputs. In this situation, with the phase inverter referenced to the quasi npn, it follows that all three stages should all be equally referenced to the negative rail. If you have a decoupler between the inverter/quasi and the VAS the hum and noise would be delivered to the inverter from the VAS output. The amplified noise on the negative rail should NOT be decoupled from the output stage and the best way around this is to delete the decoupler. OTOH, the positive rail is already decoupled by the bootstrap; and the input singleton transistor is referenced to the input base, which is decoupled to ground. The output node, at the emitter, should be very quiet because it's a nfb node and it's source is the speaker, which is probably the quietest node on the amp.	RC filter at -Ve rail
1475	Download the file "Gerber.zip" located at post **1354** of this thread.	DACZ Gerber
1477	I take a liberty to explain what Hugh meant with regards to R10 :) **R10 provides a bit of a local (nested) feedback from the VAS buffer to the mail feedbzck junction point.** Unsolder and lift one side of it and have a listen with no R10 in place. Then solder it back and have a listen again. Do you notice some difference? What option is better (with no R10 or with R10 in place)?	R10

1478	Interesting Hugh. Doug Self that demonstrated a thd improvement with the RC filter at that node, although I couldn't say whether it was with a CFP or EF2 output stage. Have you ever tried cascoding the singleton IP and moving the comp cap connection to the cascode emitter to isolate it from rail hash? I think it was Samuel Groner who demonstrated the technique in an an audio power amp; it is commonly used in IC amplifiers apparently. Samuel's example used an LTP input but the technique is equally applicable to singleton IP of course. It can be done with one transistor, two resistors and a small filtering cap. I have used it myself in a couple of projects and didn't think it sounded worse for the cascode.	
1479	Indubitably, Sir, you are absolutely right. I am still digesting your comments on EC and removal of the crossover artefacts. I am smart enough to realise I cannot disagree. Hell, you might be damn right - and if so, I learn something more about this art. Ranchu, Yes, I have added a cascade at the singleton and it works. I've also tried a CFP for the singleton, and the results are not so wonderful so I gave it away. My cascade is not exactly as you are suggesting, but certainly it works very well and I use it in the Maya power amp. You mention D. Self; I try to move beyond his views and opinions; he is very good at the analysis and I have learned a lot from this, but does not offer too many new topologies, which I feel are the goal of superior audio amp design. Some of the best topologies come from Valery, Alex Nikitin, Pass, Juma, Ilimzn, and JLH. X, Valery nailed it. Raise on end of R10 and the amp will be operating entirely in global feedback, with minimal THD. Connect up R10 and the global feedback will be reduced to 68/1.8 = 37.8 = 31.54dB. This obviously increased the THD, BUT, it does change the profile of the THD, increasing the H2-H5, and there is another effect you might find that most people would not notice at all. BTW, to be fair, 'intuitive' logic is as often incorrect, so it's very careful to be absolutely sure of this. I explain the words nicely; the concept might not be so wonderful! A lot of dubious concepts are beautifully described with 'perceived' logic.....	
1480	A couple of years ago I built the basic version of Bigun's TGM8 amplifier, which is heavily based on Rod Elliott's P3A amplifier but with a singleton IP stage. At the time I was (still am) VERY familiar with the P3A - it was one of the first amplifiers I built and I spent well over 100 hours tweaking it. I remember when I first compared TGM8 and P3A using the same basic PSU in my test rig, I felt the TGM8 was a little lacking in some respects. However then I swapped in Jason's cap multiplier that I'd built for the VSSA I also had on the workbench and TGM8 was improved, while any improvement with the P3A was negligible to my ears.In the end I settled for a stout CRC filtered PSU on the TGM8 and like it very much, but I came away from that project thinking that some of these simple designs do require higher quality power supplies.	TGM8 amp , P3A amp
1483	**It might be worth trying an mkp 220pF 100V for C10.** **A high K ceramic for C10 will change capacitance as the voltage swings, especially when it swings very high.**	C10
1484	I have some 220pF 100v film caps on order. Can't believe I ran out of those unexpectedly. This amp so far measures slightly better than previous quasi from distortion at speaker as measured with microphone. Bass performance is slightly cleaner. So far very nice sounding - no complaints. The nice thing about a compact 50w amp like this is possibility of doing a "lobotomy" on an existing commercial amp in a case. Just pull out existing discrete power amp board and replace with something small like this. My Yamaha RX360 is a good candidate. Of course, stock PSU probably is not up to the task compared to a 250VA toroidal and nice CRCLC filter. Also, this is such a pretty amp - be a shame to cover it up	
1503	solder is applied to the traces to increase the current carrying ability of the main power traces. the layer of solder over the copper trace increases its thermal mass. by increasing the thermal mass, the traces heat up less and hot spots on the traces are reduced.	
1505	I simulated 100K resistor from collector VAS current to feedback node at my FX8 amplifier. THD was increase but H2 dominant. It tested by a friend of mine, he said the sound more warm and the vocal more forward. He like used 100K resistors	R10_100k?
1507	Long term listening on DACZ layout: **I am using KSA1381 drivers/VAS vs MJE350's and using the Onsemi BJT vs the Toshiba 2SC5200. Also using film cap on C9 vs ceramic.**	XRK_BJT_C9 cap
1516	BTW, I have found that if you use a **IRF140** as the upper nmos on this amp and you **are using a snubber**, you can improve the sonic performance markedly if you decrease the **stopper to 120R from the present 220R.**	IRF140_Gatestopper cahnge
1549	DACZ attachments were in **1354** AKSA said:I have redrawn Thiago's schematic with my suggested values for best sound. **988**	
1557	Thiago PCB, Layout	
1562	Idefixes SMD-PCB, layout	old post 2481
1564	unkle phunk pcb	
1570	Very nice looking layout. I like the BD139 on top of MOSFET without any flying leads. Under hung stacking. Cool.	unkel Phunk
1571	meanman:-Thanks.I like it too! prasi:-Thanks.That`s a good catch.I have rectified the situation.12mm diameter cap in now.That should be ok,I think?...that`s me being a little bit lazy.Can just check my catalogues later. AKSA:-Thanks very much.The moniker comes from being the life of the party in my young days.It is shortened from "uncle funk":-i`ve changed it to "unkel phunk",and "phunk" stuck to this day.The logo is from my first try which was a little bit too "busy" for my liking.Found a couple of threads on the forum with regard to Sprint and just started implementing.Yes,I had to start laughing when i saw what was looking back at me. AndrewT:-Thanks for noticing.Will have a look at R1&R2 when i get home.I may have swapped them around inadvertently. C11&C13-I have looked at the gap and it kind of bothered me.Thanks for clarifying the issue.I will make the changes to the caps with respect to the ground gap. Sgnd&Input:-Will put them closer together. xrk971:-Thanks man.Love the energy with which you tackle new projects. As said before,a second set of eyes does help.I`ll wait a day or two before i post the amended layout.	unkel Phunk corrections
1581	Now i have finitely finished the boards paralleled to other projects.;) First i could say: it does not zeroes the Offset with two red LED- 1,8V- to much voltage left over ~1,7V with fully cw turned 500 Ohm trimmer. I soldered in only one greenLED and it works fine than. R5 is 100k; D7 is 3,3V; N-VFet is: FQA 19N20 Vgs ~4,6V; BJT is 2S3263 LATP Sanken. Bias runs stable 39,4.....9mV and offset from 1....4mV. Heat Sink is a Fischer SK53 75mm high- dissipate 0,75K/W. Now its time to fix both channels for stereo listen test.	Bangla H
1585	I have **Panasonics** that are same shape and color as CBB. The CBB's I have seen to work well and sonic signature is good - especially the 250v or 400v rated ones.	C12
1587	pcb, gerber by Thiago	Thiago Gerber
1589	CBB is a polypropylene cap. Can be easily confirmed by measuring the value at room temp and heated in very hot water ! The capacitance will drop for polypropylene. For polyester it will increase.	
1592	I have implemented the changes to the layout. I have also made a couple of changes and have included the old layout in zip format as reference:- 1.D1,D2&R3 brought in line; 2.D5&D6 shifted to the front of the output mosfet contacts.Was a bit worried about the lead lenght of the outputs.Datasheet says +- 14,6mm. 3.Led1,Vr1,C3,R6,D9&D10 shifted around to get some clearance because of the 12mm dia caps instead of the 10mm dia caps that were previously there.Left C11&C13 where they were because the only space on top for C13 would have been very close to R21 which i did not like because of R21`s heat.  Let me know which options i should include in the final layout as i want to finalise & order pcb`s by the end of this month(surface mail takes+- 6 weeks,so will be good to go for the big days).	unkel Phunk

1599	Here are some speculation about my used input cup. It is a Nichicon QXP- other named it Relcap. On Greg's DX Amp side i noticed it first time and was searching some information. Reliable Capacitor (RelCap,AudioCap,Multicap)PPFA,PPFX,PPFXS,RT,RTX,TFT So i bought some 1uF from Mouser and tested it in FetZilla with excellent results- if you keep in mind: size/price/performance relation. :D :D Than i also make tests with MBGCH- really a Favorit too and with MBGO- that is the one i prefer for long time listening- smooth and relaxed, but feels lost a bitin clear transparency to QXP. Finally i have add a little 10n K40Y-9 PIO to QXP- and if i trust my ears i can live long time with that. On VSSA/Spooky boards i use a combi with DME cap with very good result. I send picture about my Favorit tested cap collection. You can see on 2 way X over board a clarity ESA 4uF to a PIO 3,3uF/250V K75-10 hybrid cap, and believe or not- that is a awesome combi in use for the tweeter in my unfinished project after long period testing. Another Favorit in bypass is the Orange Drop P715/716- what i have tested for decoupling in Tubeamp and on Circlophone. One of my loved overall performance/price is the Audyn Plus- the white in picture, only 0,68uF/800V- a huge one. I feel it is not thrown away money if you like to test yourself. :rolleyes: I am not so good in details to explain but i trust my lazy ears	Bangla H
1600	I noticed your **FetZilla** in your photos - how do you find it sonically? I will be very interested to hear your view comparing the **FetZ** will the Quasi. Very different designs, but a few of the same design tricks..... Phunk, You have done a very nice pcb for the Quasi, with all electros orientated e same way and the output devices dead center to the amp can be located centrally on a small heatsink. Elegant! How many different designs do we have for this amp now? Three, or four? Perhaps it's a pretty good circuit! Notice that the good circuits are simple, low parts count, and well reviewed sonically. No one notices too much if the THD is high.....	AKSA
1601/1606	after several days listening with burn in the foil cap (same as in FetZilla) this amp plays very cool. :D :D The PSU is only 28VDC- 2 x cap bank each 4 x 6800uF/40V + MUR820. On Input is a 100k pot- and this animal has a lot gain- dynamic goes forward, if you turn pot more cw- wow. It has an fresh breath. From mids to topend it is very clear and transparent- nuances in micro details are easy listenable. So you mean losses in bass- no no- it plays deep and well contoured too- even slimm not thin!!! Stage is on speaker line and with good material goes easy form speaker forward, backward and also wider out of speaker with more clear separation as other builds- FX8 is a bit more closed together. This amp is close in neighborhood with other who i like in tonality- every is a bit different what is preferential. And here comes the Fetzilla in to the game. :p half finished case now It could be because i have add a PIO to the input foil cap this gives a other coloration?That is the point where wins the FZ to me. The female vocals, brass and strings have a bit its own color and bit more fuller bodied tonality- difficult to describe, but i like that more for long listening.Could it have to do with LatFet there? on other hand the LAPT Sanken plays fresh, not harsch- i know.With Sanken 3263 i have build the W.d.Haan Nishiki Quasi Hybrid Amp, butnot fully wired now- pic. It has a 6N1P in srpp on input with ~320V Ub anode.That one plays in same league for my opinion- have to finish wiring.And than its time to create a new case for that Quasi animal. :) and get a steady place. Ashok the only different is the paralleled 10n cap- on Quasi is an old FKC-polycarbonate (ZM used 1uF- there is borrowed idea). The FKC i have tested on Apex FX8 with 10uF electrolytic with surprisingly very good clean sound- my indicator is clapping hands- very precise, same on Quasi.Today i have better ears and registered again a very good 3D imaging of Quasi and fluide musicality- one song plays very delicious :sax: :yummy: The Fetzilla is there a bit different i would say- LatMos as OP, warm class ABbias point and the refined PSU- CRC, what Ranchu has worked out with any more members and well supported by Hugh. :Dlf there is more interess- MM has done a great offer to us- not many registered that- of course that one is a bit more expensive..... and so on...I have add to QXP there the K40Y-9 PIO cap- same experiment done on Jasons VSSA (with long antennas cap legs- bad!!! :confused: :p) and a DME10uF- works also great with any magic in sound- i like it. I tough every one does it's own experience with caps and what he like. :eek: Another impressing thing is: if i switched off the Quasi it is slow discharging-near a minute you can listen on speaker- like a tube amp- electrodes flowing. Makes me little smile there- only nice. :)Could it be because the VFet stays permanently ON?	Bangla H
1604/1605	Very nice builds BanglaH! I looked around and could not find any Gerbers for the **Fetzilla**. Are they only available as pre-made PCB's? Is there a link to where to get the PCB's? One of my favorite input cap combos is a very small (and inexpensive) 10uF 50v MLCC to get the bass, bypassed with between a 100nF 100v to 1uF 250v film cap. Sounds just fine to my ears. The 100nF option os overall very compact and fits on the smallest of amps.	Fetzilla is a group buy which is on hold_ input cap
1609	the orange drop cap thanks Hugh and Ashok for kind reply and reflecting. Yes - experienced in building (not every project with success :(), and well listening over the years- must be mindful don't lost good quality ears in older days now! :p :D. Ashok- if you could build the little FX8- you would be surprised how good a LM without source resistors.For comparing without in put cap i must set under **current my shaan/olafk peeceebee.** Mr. Pass and 6L6 in Pass Forum using the Elna Silmic II very satisfied- that i will try next on ACA with my loved orange drop P-715/716 (size, price, performance) Here on Quasi could be good to play with Clarity SA or different big PP- i feelthey have more dark background- more flattering ears. :rolleyes: Here comes again the Fetzilla in- 0,1R on source- high quality- robust stability.Next time i have finitely to test the 100k option in PL position to compare bass response- what would happen next!!- promised! :)We keep too the FZ on life, hopefully. :happy2: And than stops it for me with deeper detailed knowledge- but i continuouslykeep on learning more. :flame:	Bangla H
1610	I will use the following...(just because I have them !) 2**SA992, 2SC1845, 2SA1837,BD139,IRFP240,TTC5200 ! If I like what I hear and decide to continue then I'll get more boards made and try different transistors also.** **TTC 's are Chinese made but it is a Toshiba product. I don't see why they should be poor in any way. I have genuine 2SC5200's and 2SC3281's also !**	BJT
1615	Guys, **the NPN output isn't particularly critical, although it doesn't need to be reasonably fast (fT 30-50Mhz) u**nless you are prepared to experiment with different driver types and local compensation.	BJT
1619/1627	pcb, scheamtic , gerber	unkel Phunk
1630/1633	Big Quasi by Thiago	
1640	No, Max, not tested. However, **I can guarantee 100% that it will work well without instability**, BUT the big question is HOW good the SOUND is vis a vis the smaller Quasi.....	Big Quasi
	https://www.diyaudio.com/community/threads/very-simple-quasi-complimentary-mosfet-amplifier.255427/page-83	
1652	I have used **MJE350** as substitutes for **KSA1381** in this amp. They work well.	BJT
1658	It occurs that if you use a larger output device you could increase the rails to around **56V** - and still use a **SINGLE pair.** **The mosfet would be a 512-FQA40N25 (Mouser) TO3-P, 40A, 280W, 250V ($USD3.28)** **The npn would be 863-MJL4281AG (Mouser) TO264, 15A, 230W, 350V ($USD5.94).**	**56V rail**

1660	That would be cool with **flag heatsinks on Q3 and the inverter, using 2SA1381.** The current through Q1 and Q2 would not be different; it's set by fixed resistors on the circuit, while dissipation through Q3 would be increased quite a bit from 56V over 42V; but still within flag heatsinks (<24C per watt). The outputs would be dissipating around **125mA** x 55V, **around 6.9W apiece.** This would need a substantial heatsink for the output devices, however, just as you suggest. But it's doable, and I cannot see any reason why it would not sound almost the same but with almost double the power! Certainly an attractive exercise as we have lovely pcbs now from Prasi, Thiago and PHunk and with larger transformers it could be quite viable since so many people like the sound of this amp.	**56V rail**
1661	I am stumbled by searching datasheet **FQA40N20** to the thread here: Maya200 with your very good explained reason to **use it # 10 :)** I use much bigger, 480W mosfets for the Maya, and yes, they have much higher transconductance and parasitic capacitances. The NAKSA 125 uses 280W devices. I could fill a page on this; it's my stock in trade for the last twenty years. Firstly, higher transconductance means there is very little change in Vgs on these devices over the full waveform, and the Cgs (input capacitance Ciss) is bootstrapped by a common source configuration. These devices have transconductance around 25S plus, where bipolars are markedly less (typically 20S for a C5200), so the waveform compression of mosfets is generally superior to equivalent bipolars by 1:1. A single pair of very large mosfets are superior to multiple pairs of bipolars; more resolution and easier to drive (no gate current). It is much easier to drive large mosfets than most expect, and in fact I found using drivers increased phase shift and gave no subjective improvement in sound. We are working with audio, not radio frequencies, and up to 20KHz a high driver current is more than sufficient drive. In fact, the Maya will do huge output to 100KHz and beyond if not fitted with a mandatory LP filter. There are some dark secrets in using mosfets in this way. They are skittish devices, inclined to self-oscillate. Robert Cordell helped me from a 1984 white paper on these fascinating devices. These days I would not use anything else, and we can thank SS traction technology for this; hybrid electronics use them in VFD modules. Thanks Steve, absolutely, different devices, and we think, you and I, that the bigger mosfets sound as good and even a bit better.....	**from post 10**
1664	There are now some very good output devices in the market in both mosfet, n and p, and bipolars too. The availability of a 230W 350V $6 4281 makes it possible to make a very powerful quasi; this device is no longer the weak link on this design. Using only a single pair of outputs should mean that the crossover dysjunction is easier to control because we do not have a chorus of paralleled outputs all chiming in, all in their own key..... **Most complementary designs using bipolars are up against the SOAR limitations; as you increase the collector current, the available voltage from C to E starts to shrink to avoid destroying the device. 200V 150W 15A devices become wimpy transistors with appreciable voltage across them; the C5200 can only pass 5A with 30V Vce. The problem is very serious with all output topologies, because the current rises, the voltage across the device reduces by Vcc - Vsigpk. Using a 50V rail, if the device has 20V on the load, then (50 - 20) = 30V must be across the output device. With 4R load, 20V across it (assuming very low source resistors) we have a minimal of 5A, and maybe more if its reactive. This is right on the limit of the SOAR limitations of the C5200, 30V/5A, so the MJL4281 is superior; 5A can handle 45V across the device, a huge improvement on Vce of 20V for a C5200.** In turn, this suggests we can increase the rail voltage, my suggestion for this BIG QUASI would be 56V, but of course this requires a bigger mosfet too (which BTW does not suffer from SOAR limitations to the same extent as bipolar) as suggested by the 280W FQA40N25.	BJT
1666	Two other Candidates **IRFP260N and 4229** Hi Hugh. Thanks for explaining, sharing any more details and knowledge. I have read a bit about SOAR- and now it's more clear- current- relation to C-E voltage- all that little things must keep in view- and with two devices thecrosstalk between this(hfe differences) too.My next would be order the bigger **AnimalsMJL4281**. Than theSanken **2SC3264** is out here in higher Voltage rating.After your presenting us the very excellent **FQA40N25** i was searching a bit foralternatives and found this: **IRFP260N;IRFP4229** http://cdn-reichelt.de/documents/datenblatt/A100/IRFP260N_IR.pdfhttp://cdn-reichelt.de/documents/datenblatt/A100/IRFP4229_IR.pdf possible?FQA are in the bag- only one click.I found also a FQA16N25- for normal Voltage use?Hi Richard- paralleling 2x0,68 Ohm 2W or 3x1Ohm 1W possible for you?Now it's time to go to Lounch- yummy yum. :lickface:	**56V rail**
1669	Big FETs tend to have big capacitance and high voltage FETs in particular tend to have really high capacitance at low voltages. But if using as a Follower you are less affected by this (the Ciss is bootstrapped) so as you point out, the Crss is what you want to look at. Capacitance isn't bad in of itself providing you can drive it the issue is that the capacitance is non-linear so best to keep a decent voltage across the FET during normal listening levels. And you want to keep enough current through it so that you are getting decent transconductance. Big FETs are often shown in datasheets with transconductance measured at very high currents and can be misleading. Bipolar devices generally have much higher transconductance (good for a Follower) but it also depends on the current. From a design perspective, Bipolars have low input impedance (base current) but tend not be so tetchy in terms of parasitic oscillations - my FET designs all have zobels across gate-drain to tame that.	
1672	Actually, I only used rather boring FETs so far. The full-version of TGM8 uses FETs operating in Class-C http://www.diyaudio.com/forums/solid-state/245619-tgm8-amplifier-based-rod-elliot-p3a.html And my earlier amplifier, TGM7, uses FETs only. The output stage of this amplifier is not my design but it works rather well indeed.	TGM8 amp , P3A amp
1673	"My suggestion is not to use any of the **IRF devices with the suffix 'N'.** If you check the datasheets you will find that the **'N' devices have lower repetitive current but higher peak current rating compared to their counterparts without any suffix; I have found that these cannot withstand the sustained current levels of output amplifiers**. They are better suited for switching purposes. I am sure IRF640 without the suffix 'N' is available and should be the preferred device for this application."	IRF without N
1685	as per my layout, **C2/C10 should preferably be a NPO/C0G 220pF cap**. C5 should be preferably be a **silver mica** as per recommendation from AKSA.	caps
1689	I have Nichicon KA **2200uF/6.3V.**	C4
1694	Ah, Marc, you will now be building the BIG QUASI?? What rails will you use? I suggest 56V dc rails, with 40Vac secondary. That MJL4281 is a very impressive device, isn't it? 230W, 350V and 15A with 100V/1A SOAR is a terrific piece of technology for a 35MHz bipolar. Should have highish beta, too.I will be very interested what you think of the sound; I'm expecting this will be one of the best 150W amps you have ever heard....	
1696	There are different SOAR conditions (easier) in quasi transistors, so given the wonderful SOAR advantages of the MJL4281 and the largely free from SOAR restrictions on mosfets, I would still s**uggest 56V rails, even with 4R loads.** That would give you a lot of power, up to **250W** given good trafos, but you would need to take careful care with the heatsinking. These devices will dissipate a lot of heat on 4R speakers, but it is doable.	Big Quasi
1700	My rule is: Max power output is roughly total Pmax of the output devices divided by a Factor. That Factor is 4 for mosFETs that have virtually no second breakdown effect, or 5 to 6 for BJT that are affected by second breakdown.Using the Factor=5 for the 230W BJT, I would arrive at {230+250}/5 ~96W i.e. a 100W amplifier from ±50Vdc supply rails.I can't see why this quasi topology should allow the devices to reliably exceed their SOAR with reactive speaker loads.	Andrew T.
1704	**Fetzilla_JFET_AKSA amp**	
1707	Andrew, Consider the soar figures on the 4281. 100V/1A is impressive; using 56V rails and 36V (65%) and the 4R load we have 9A pk in the collector on 20V at Vce of the quasi. I don't have the datasheet on hand but this is within its remit. Ergo I defend my comment and contend that your 'stand and deliver' is not in the spirit of this forum. You would be somewhat circumspect in person and in this sterile environment it is very, very easy to be rude without even intending.	AKSA

1709	If you only drive a resistive test load, then you can extract a lot of power from a one pair stage. And do so reliably, provided temperatures stay within your design limits. But our speakers are not resistors. They are reactive and this reactive load places a lot more stress on the amplifier, particularly the output stages and the transistors that drive that final stage. When one takes account of the reactive stress and the higher operating temperature, one finds that the maximum output power is a lot less than would be measured/predicted for a simple resistively loaded amplifier reproducing audio/music signals. **One must account for the effect of the reactive loading.** **R.Cordell gave a guide on what is acceptable.** **Jan Didden has published a guide giving similar guidance.** **I adopted the David Eather analysis that Bensen turned into a spread sheet for us.** **All three of these methods give similar answers. All three predict the much reduced maximum power output when reactive loads are used.** This has nothing to do with trying to be rude. I kept quiet when you suggested some enormously high maximum output powers. This was prompted by Xr's comment and when I saw a Member about to adopt a potentially damaging build I felt compelled to say something based on what I have learned from our other Members.	
1716/1717/1726	CAP X Elliot_Cubie _Juma CapX	CapX
1735	IRF530 (as well as IRF540) has got smaller die and smaller package (TO-220). As a result - roughly 2 times lower capacitances and half the power rating. Also note the voltage - it's only 100V maximum. So, talking about the equivalent replacement for IRFP240, I would consider 2 x IRF530 in parallel (with separate gate stoppers and source resistors for proper current sharing), assuming your rails don't exceed some +/- 48V (each output transistor sees almost rail-to-rail at high swing). **IRFP250** and IRFP260 are not just the "next generation" - they have got bigger dies, roughly 1.5x times bigger for IRFP250 and 2x bigger for IRFP260 (same, as the power rating). However, the capacitances grow at higher scale, appearing 2x for IRFP250 and 4x for IRFP260. So... these guys are powerful, but may require the driver stage redesign (higher charging current capability) and possibly compensation amendments. **The whole IR HexFET product line analysis is showing that IRFP240 is somewhat ... unique in terms of linear audio applications due to the following combination of reasons:** **- It's got a complementary IRFP9240;** **- It's got a relatively high power rating (150W) and good voltage rating (200V);** **- It's got relatively low capacitances for this power rating (still requiring proper driver stage);** **- It's inexpensive, making the whole amp economically efficient, especially if multiple output pairs are used.**	N_Mosfets
1740	Idefices_Marcs PCB	
1750	All my commercial amps use an independent rectifier and CRC for each rail. It seems to reduce noise, because there is no common tap (CT) in the two (independent) secondary windings. When you connect a CT to the power earth, and then to the signal earth, you introduce more mains noise to the output of the amp. If you have independent rectifiers, you eliminate connection to the CT, and you can connect the two windings via the power ground at DC. This makes the amp quieter.	CRC
1763/1764	Big Quasi ??_April 2017	Big Quasi
1769	But I recommend a single MJL4281 (350V 15A with large SOAR specs and 230W). That will give you more than 150W into 8R but do not go over 225W into 4R. And cool these very large TO3P/TO247 devices!	Big Quasi
1773	**TO264 package MJL device recommended by Hugh**	
1774	Anyhow, I set it up in **semi-class A with 500mA bias current and +/-32v supplies** (measured under load) and added a 3300uF Panasonic FM 35v cap with a 100uF Elna Silmic II and 1uF Wima MKS in parallel for cap coupling the headphone in true SE Class A fashion. I listened with my 8ohm speakers first and was amazed at the bass that was coming out. My calcs say that the corner frequency should be about 6Hz. I am doing this to ensure that the DC offset of this amp can never damage a sensitive headphone driver.	**Semi Class A**
1783	**Thiago PCB, gerber_Big Quasi**	Big Quasi
1787	WHY we like a QUASI Just to kick along this thread, I thought I'd offer WHY we like QUASIs. First, they tend to produce high levels of H2 and H4.Second, in the hybrid version Ranchu (Christian) and I developed, the upper nmos, driven from a bootstrap, reduces crossover. WHY does this happen?It is to do with the bias system and the low transconductance of the upper nmos device compared to the lower bipolar. Here is a LTSpice waveform of the output voltage (red) at 32Vpeak - over 60W from 42V rails - and the current passing (green) through the upper nmos right through the entire cycle. If you follow the current passed with the upper nmos you will notice it never drops 18mA right through the complete waveform. (This is not that clear but if you magnify the curve is never drops below 18mA for a quiescent of 115mA). The nmos never actually turns on, in contrast to a usual conventional AB amp, where both outputs turn on and off alternatively through the cycle. It is well understood that output device switching - commutating - causes crossover, specifically odd orders and at high levels, H5, H7, H9, H11 and even higher. There are 'machine' tones and do not sound good. The Quasi has the upper devices constantly on, though the lower, bipolar does switch. Consequently, the odd order harmonic levels are much lower in a quasi than many Class ABs with conventional, complementary outputs. This is the reason I like the QUASI, they are audiophile friendly....	Ltspice Quasi
1795	Driving The Quasi Transistor This post answers a question from Max (Smart 21) about the drive on the quasi amplifier on this amplifier. I should have given the answer weeks ago, and I was wrong..... my apologies, Max! Most quasis use the same resistor value in the emitter R19 (off the output node across the Baxandall diode) and the collector R14 (across the base quasi to negative rail). The schematic is attached. I changed these equal values to R19 120R and 150R R14 on a hunch. When we set up the bias, say around 125mA (42mV) across either of the 0.33R output resistors, we set up 6.20mA into the emitter of the inverter transistor which drives the quasi device. This means 735mV lies across R14, and if you subtract the 42mV across R21, you have 693mV across R14, which passes 125mA quiescent and 4.62mA through R14 and remaining 1.54mA into the base of the quasi device, Q7. These are LTSpice figures, in fact, but steady state and very accurate. Since the inverter transistor, Q5, passes 6.20mA into its emitter, this current comes from the output node and via the baxandall diode D8 and the associated resistor, R19. If you pass this through a 120R resistor, the drop is 744mV, and since this current is across D8, it will be already on passing current to the inverter transistor. Spice reveals that in fact the diode D8 is on, passing 2.11mA, and the remainder, 4.09mA, is passing through R19. There is switching taking here; the diode, the resistor, and quasi. This switching causes higher harmonics. When you measure the 120/150 combo, you get this at +20dB output, attached as Ranchu120-150. When you measure the 150/150 combo, it's very similar here attached. I can actually see no reason to make these resistors, R19 and R14, different. They should be the same value; in this situation, I'd use 120R for both. In the FFTs, all quiescents were set to 125mA for correct comparison.	
1798/1799	An **LU1014D** might be interesting here too for a smaller quasi headphone amp or small full range speakers. BTW, there are higher power **SiC Mosfets** available at digikey, have a look at for instance **SCT3120AL and SCT3060AL.**	headamp with LUD**, SIC MOSFETS**
1801/1802 1811	Set the bias voltage at 61mV. However I can get offset voltage down to 393 mV only. :{Using a 200 Ohm trimpot on VR1, 1N4148 diodes on D9, D10, and 10 KOhm resistor on R6. Any suggestions on how to get the offset voltage down? Try replace the two diodes D9 and D10 with a green LED. That will drop 1.95V rather than 1.3V, another 0.65V more, and you should be able to back off on the 500R pot. The LED bias did the trick; after installing the green LED, the bias voltage fell into the minus range and brought it up to 0 mV. Thank you for the guidance on getting this fixed so easily.	DC offset

1812	Much credit must go to Ranchu. He did the hard yards, including the original schematic, the ongoing build, and the critical listening. But thank you for your comments. The issue of setting a reasonable narrow DC offset on any amp amp comes back to the bias resistor on the base of the first transistor, and of course, the beta of the first transistor. You need to know exactly the collector current and a guestimate of the beta. Since transistor betas can move quite a bit, this is a bit like blindly pinning the tail on the donkey! Very small currents, typically 10-50uA, flow into the first transistor on the Quasi**. I try to design for beta around 100**, not too high, much less than many like the K1845/A992, which have beta up to 600 and usually around 250. This base current must pass through the bias resistor, 33k here, and if it's a gain of 100 for the 2N5401, you divide the collector current (1mA here) by 100 to get 10uA. Multiply this by the 33k bias resistor, add the 1.8V dropped across the series 1k8 feedback resistor, add again the 0.65V pn voltage of T1 and you get a total voltage at the top of the 33k of ([1.8Kx1mA] + [1mA/100]33k + 0.65) = 1.8V + 0.33V + 0.65V = 2.78V. Since were are aiming for 0mV at the output, and we are using a pnp T1 and the current is passing from output along the chain to the 33k bias resistor, it must be negative. So this voltage at the TOP of the 33k bias resistor should be -2.78V. Any increment up or down on this point will be passed identically to the output; so if we set -2.80V, the output offset will be LOWER than 0mV, and be at -20mV. At -2.76V, the output offset is +20mV, and so on..... I try to have a range of less than 100mV plus and minus so that if the amp is set at either extreme ends it would not destroy the loudspeaker!	AKSA_ DC offset
1817/1819	This is a moot point. I tend to set them lower rather than higher because I seek efficiency, particularly in a hot climate like yours and mine. But if you set the quiescent at say 60mV, which corresponds to 180mA/6.1W on each output device, you might notice it actually sounds a bit better because when **you do the modelling you see that the harmonic profile changes.** I do not have a quasi here to test with, so I can't be sure that at **180mA** it sounds better than at **100mA**, but you are invited to try some critical listening and see if you can hear a difference. The other issue is that the quality of the mains changes during different times of the day; one guy who may know definitely might be Terry, Stillforgiven. He has done a LOT of critical testing and knows it all - he is about my age (I understand, hope I'm correct!). You might also **try 250mA and 350mA too - just to see how it sounds! Check the offset after changing.**.... it should be no problem at all and even at 350mA the dissipation with 34V rails is only 0.35 x 34 = 11.9W on each device, will within the output devices with good heatsinks.	Bias Current better THD?
page 92	https://www.diyaudio.com/community/threads/very-simple-quasi-complimentary-mosfet-amplifier.255427/page-92#post-5129110	
1832	After raising bias **to around 300 mA (100 mV)**, it seems the overall quality got better. Only one board has been tested, with 4 ohms load (Sony Sigma vintage loudspeakers). I think I will try the other board with some better parts, like a genuine **MJL4281AG** and some other good mosfet. Hugh, do you think **IRFP26N60L** could do	**Bias 300mA**
1835	Some (silly?) questions for those who knows miles ahead: 1) How would I come to know if C8 is needed? 2) What could be the disadvantage of using MJE350G instead of 2SA1381 for Q5? (my case) 3) What could be the (sonic) disadvantage of using a ceramic capacitor for C5 (33p)? (my case also) I will post some readings as soon as possible.	Caps and BJT?
1836	1. **C8 may be needed if the zobel 10R resistor R22 gets hot during operation**. The zobel resistor on the output node, in series with C12 100nF, is a stability clamp with feedback amps and a fix for RF and EMI which can find its way into speaker lines to the amplifier. If that resistor is even slightly warm, it indicates supersonic oscillation - you can see it on an oscilloscope too. It is a sensitive test for instability at high frequency. If R22 gets hot, use C8 across base collector of the phase inverter. 2. MJE350 is a slow transistor. In scanning through pdfs from Motorola, ST, Fairchild and ON semi I have not found anything on the speed, but I seem to recall from the eighties that it's 10MHz. They are rated to 300V, 20W, 500mA and hfe 30-240 but the beta is very low, typically 75 at 10mA, and I would not use them in a VAS role. I strongly recommend the Fairchild **KSA1381**. They are 300V, 7W, 200mA and hfe 40-320. They are rated to 150MHz at 10mA, hugely faster than the MJE350, and very low output cap of 3.2pF. Very good transistor for a VAS. 3. There is some controversy on this cap, **C5. By tradition I also use silver mica, but they are difficult to find these days. I would suggest ceramic NPO**, easy to find, and they work well in the lag compensation role.	C8, C5
1851	I have tried **CLC on a SS amp. But unless it is a Class A**, you must use small inductors because otherwise the screw up with the voltage supply because of the wide current variations. Class A is different and it works well, like a tube which operates at relatively constant current. You can use **common mode chokes in Class AB SS; the P3717A Coilcraft works well on my Class AB amps. But they are tiny inductances, and thick wires to keep DCR low.** Fixing tube hums, particularly DHT, is akin to maintaining tune on a hopped up hog.....	CLC
1853	A new Quasi developed in partnership with Hugh Dean is born: **the HyQu, a Hybrid Quasi headphone amplifier u**sing smaller output devices and single rail power supply, with of course, cap coupling on the outputs to ensure safe operation with headphones. Here is my hand etched prototype running on 24v rail and 95mA bias current. Sounds great and measurements are not too shabby either. Here are FFT's for 1.41vrms into 270ohm load - about 0.003% THD with about 29ppm H2 and 9ppm H3 and descending higher harmonics with a -130dB flat noise floor. Suppression of the wall AC mains 60Hz worked out pretty well too. **This will be a product line so sorry, can't share the details of schematic.**	Quasi headamp -commercial
1866	PCB by Farjon , post 1347	
1870/1872	Please see attached where would this be coming from, just finished running some tests. Used **2sa970,2cs2240,mje350, bd139, irfp240 & mjl4281 at 42v rails**, bias set around 100ma but not stable when increasing signal. Try 33pF between base and collector of inverter transistor which drives the output quasi.	unstable, C8
1877/1878/1880	Having built 3 variants of the Quasi - and they all work with great stability, all I can suggest is to switch to the recommended small signal devices. Use 2N5401 and 2N5501 and KSA1381's as a baseline case (they are plentiful and cheap). IRFP240 works I know. MJL21194 seems like it should work. Are your DC voltages at all the nodes consistent with predicted or measured points by others who have working Agree with X. I think maybe the input transistors should be changed, this should reduce the speed and bring back loop g examples? Try increasing the base resistor on the MJL. I would suggest 4.7R.	unstable
1882	Ok had another play, mjl4281 replaced with **mjl21194** all traces of oscillations gone. Happy days, oh yes it sounds very good indeed thanks to all. Don't bother using mjl4281 without circuit rework.	**BJT mjl21194**
1885	This is not expected but I would expect a **1nF between base and collector of the 4281 would prevent oscillation.** But odd behaviour since a C5200 is just as fast as the 230W 350V 4281.....	**MJL4281 oscillation**
1897/1899	**Asymmetrical clipping.** Sorry for this late post but i just came across this thread now. I have built the citation mosfet amp in quasi mode and I have built another similar variation of the citation as well. Much earlier in this thread you all addressed about the asymmetrical clipping which occurs where the negative half cycle clips before the positive by about 2 to 4 volts. Well I have seen this myself and i would like to add some more info to this. In the citation topology the differential input is PNP driving the NPN VAS on the negative rail and bootstrap end on the positive rail. No upper drive transistor and lower drive transistor for quasi operation. In this setup the negative clips before the positive. Now if you install an upper drive transistor just to keep it the same, there is no difference at all. It still clips as above. Now with another amplifier build where the differential input is NPN driving the PNP VAS on the positive rail end, bootstrap on the negative end, no drive transistor on the VAS end (positive side) and drive transistor on the negative for quasi operation, the amplifier clips exactly opposite. The positive side clips before the negative. If you again add the top drive transistor, no change still clips positive before negative. My question is if BJTs are used in these setups the clipping is equal. I just cannot see why the mosfet setup does this. Same drive circuit in both scenarios. For a simple setup I think these topologies need more complex drive cicuitry to accomodate mosfets than BJTs. Just some more information that i have experimented on a bench not on a simulator program. Regards. All said is good. Although the point I am addressing is the clipping changes from negative to positive when the VAS is revered. Even if you do not use bootstrapping the clipping is not equal with mosfets. But in BJTs the clipping is equal in all aspects. Regards. Billy D....	Assymmetrical Clipping

1898/1900	This quasi uses a bootstrap to drive the upper mosfet from the VAS. This means that the mosfet gate can be driven **ABOVE the positive rail; using a CCS**, there is a couple of volts restriction preventing the gate driven higher **than 2V lower than the rail.** **With a bootstrap you can drive the gate easily to the same voltage as the drain, and this means that the source can be raised another couple of volts, increasing headroom for the amplifier. This is the primary reason we used a bootstrap - it offers more headroom (three or four more watts of audio),** but it actually sounds very good on voice, and it is a passive system, rather than a CCS, increasing reliability. **Yes, and you put your finger on precisely why a mosfet at top and npn quasi at bottom was the reason we chose this odd topology. Spice indicates that the clipping is pretty identical pos and neg, and this is very elegant for a quasi.** When you invert the signal at the OPS predrive, the concertina action of the inverter consumes headroom and it's a problem you can only reduce with low bias outputs, like a bipolar npn, but not eliminate. The JLH has this same problem for precise reasons, in fact it's less efficient than the Ranchu/AKSA quasi. If you create the inverting drive earlier in the amp, for example in a Siemens amp from the 80s where it's done at the input LTP stage, you can eliminate this headroom issue completely, but then the upper npn OP device clips earlier anyway. BTW, an asymmetrical clip has no effect on the sound quality as long as you keep within clip, same for any amplifier. I'm not sure if you are being negative about this amp, or positive. It is an interesting amp design to reduce headroom issues. A quasi is a mass of compromises.	AKSA
1908	All true, but this is not actually the aim. A LTP is conventional and works very well, and was considered..... like the CCS in place of the bootstrap. But these conventional approaches were found wanting, so we looked elsewhere to create a better sound. The idea is to create an amp with sound quality is exceptional. If you build a conventional design, it will sound like just the others in the market. We wanted to do something different, and Ranchu and I felt that this amp was head and shoulders over the conventional LTP/CCS circuits of yore. Of course, you need not build this, or any amp and prefer to discuss the schematic. That's cool too!	AKSA
1912/1913	Gooday all. Just need a bit of info please. I am going to build this amp. I will be using **MJL3281 and IRF250 devices**. I have transformers for +-40Vdc and for +-50Vdc. The load will primarily be 8 Ohms. Will the 50V be too high for the SOA of the transistors or should I stick with 40Vdc Actually, I would use 45V rail if you can manage it..... And the outputs you chose would be just fine!	
1915	a friend **requested a double sided for power tracks.** i want also to share it here. DACZ pcb	
1929/1930/1935	Thiago Silk and iron pdf Searching, I think the original it's found on post #1587.	
1938	Tiago PCB, gerber_2017_08_17	
1959	I feel it shouldnt hurt to use version 2 of thiele ckt on speaker terminals._universal thiele circuit	https://www.diyaudio.com/community/threads/universal-thiele-circuit.302658/#post-4965313
1964	DACZ Version_schematic, gerber_2017_08_30	
1964	Yes Nicola, the faston hole is missing. same question from my friend.. i recompile the gerber.. pls let me know any other issue to correct it. the smd file is there if you have a 100n smd. if you can notice there are two C11.. one smd and one through hole.. u need only to fix smd parts or the through hole parts, not both.. same as C13. the other smd pad is J1 below D10. Solder it if you don't use D9 and D10. See the schematic.	
1965	Prasi, Ok thanks for that. So the origional zobel stay's on the amp board and a second zobel is then added at the binding posts with the ouput coil and resistor. Hi Jan, Thats correct. Whats the harm in trying something that makes your build super stable. It may even just be a placebo:D. regards	
1987	Try a 2.2nF cap across the base/**collector** of the npn quasi transistor. The OnSemi device MJL3281 and the MJL4281 are very fast and require a little damping.	
2008	Thiago's PCBs are here.	stereo amp by Thiago
2010	JLH amps by Prasi	
2019	R1 is there to stop the input cap from charging up and causing nasty pops when the input cable is connected/disconnected. The value isn't critical but it needs to be high enough so that it doesn't excessively load your source equipment. Any value between 100k and 1Meg is fine.	R1
2027	advised to use **KSC1845** for the VAS, Q2,	Q2
2031	Christian and I designed it from the POV of easy, low count components, conventional in terms of the topology, but one difference; npn for quasi, and nmos for upper device. It had to be cheap, small, and perform very well sonically. We were not too concerned about the THD, which is around 0.06% but mostly H2 and H4. Many years ago there was a very good quasi produced by an Adelaide guy, Con whom I later met. It was excellent, designed for high power, and elegantly designed and drafted. It was, like most forum guys realise, an archetypal Oz design; practical, inexpensive, powerful, reliable and conventional. We wanted the same, but a bit more care with the harmonic profile, and since so many pcb were created for this, I think about four of them, all very good artwork, it must have been built all over the world. I design a lot of amps, but keep the best for my commercial products. But Christian and I have been pretty happy with the Simple Quasi. We'd noticed that complex, low THD difficult amps were magnificent designs, but most people did not build them, too difficult to get 'em going. I design simple amps because I am not smart enough to design complex, low THD machines, although I have a good repertoire of topologies. Enjoy Phunk's artwork, he did a paisley job, didn't he?	AKSA
2035	Looks like Thiago substituted BC560 for 2N5401 and BC550 for KSC1845, and BD140 for KSA1381. Not sure why (maybe the usual parts harder to get locally?) but he says it has been tested. **I think KSA1381** has special properties and may sound better than BD140. They are pin compatible at least.	
2046	These are high transconductance devices, and I use **220p and 47R** in series across gate and drain. They are snubbers, and they damp out the oscillations which are common with **high Gm mosfet**s, a Cordell trick from the eighties.	AKSA
2063	ou are absolutely correct! Many small signal transistors will work in this amp, but variations will change the harmonic profile more or less in unexpected ways. The big issue is the **voltage rating. We have 42V rails, so we need to have Vceo figures on all these devices higher than 85V and preferably 100V or even 120V. The A1381 is rated to 300V and 150MHz; far more than we need. The 5401/551 are rated to 160V and 150MHz too, but BC557/547 are rated max at 65V and 300MHz** - not adequate in this role. Some transistors are noisy too, so you have to avoid them as well.	AKSA
2086	Also, on inputs, the BC550 and BC560 cannot take the higher voltages and H**ugh recommended the original 2N5401/5551 but note that legs on those are different. Apparently, 2SA1381 and 2N5401/2N5551** are hard to find in Brazil?	
2102	Also, I intend to measure and compare THD and FFT with the different outputs, so that might be something of value to others around here. The **FQA40N25** is still not in stock at Mouser though, so I don't know when I will get Amp#3 going. I had a look at FDA38N30 as an alternative, but the Forward Transconductance is only 6, and as I understand it, a higher value is desirable here. Or?.. I think Hugh may have written something about that, but can't find it now.	MOSFET FQA40N25
2103	I am planning to do: Amp #1: IRFP240/MJL3281 Amp #2: IRFP250/MJL4281 Amp #3: **FQA40N25**/MJL4281 (- and possibly improvise dual 4281 devices, to better match the FQA40N25)	
2107	The **38N or 40N** is just fine. In the topology used, the transconductance of these devices is large driving by the reciprocal of the source resistor; in both cases using a 0.33R resistor the transconductance is dominated by 1/0.33, so around S=3, is quite OK. Only if a mosfet is used in common source is the transconductance important.	AKSA
2110	Hi Prasi, No, I haven't tried yet with this amp. This one has BJT and vertical hexFET so potentially could suffer from thermal runaway if Vbe multiplier temp comp is not set just right. It's a bit more sporty to **push 1.5amps through it. I think Hugh has told me before that there wouldn't be much to be gained sonically and it would just waste a lot of heat and be liable to blow up.**	Class A?
2111	However, Jan, give it a try - it might even sound better, stranger things have happened! I would try 49mV, that will be close to 150mA quiescent. If it does not get too hot and sounds very good, it might be another option.....	Class A?
2113 2115	THD does not tell you much. Most of it will be H2 and H3, essentially not an issue for musicality. It does seem a little high, however, I would expect no more than 0.06% at +20dB output (12.5W into 8R). It could be oscillation, can you see anything amiss on the CRO? I would not change the base or gate stoppers. They are pretty right as they are. If anything, I'd add 2.2nF between base and collector of the quasi npn, Q7. Currently running at **100mA, with Hugh's advice started with 2.2nf on mjl4281** ran it through the scope all good, eventually settled on 1nf.	Q7 with 2,2nF

2117	**I have now added a 1nF cap from Base to Collector, and changed the 3V3 zener to a blue led with Vf 2,83.** Result: T**HD at 1W dropped from 0,4 to 0,07%** (with Vq 50mv, i.e. Iq 156mA), and I got a much better range of adjustment of quiescent - it can now go down to 4mV). Distortion residual shape (from my HP339) looks relatively good, but not excellent. **At 20W output it is still okay, but nearing full power, it gets ugly.** I look forward to seeing what changes a different Mosfet will bring. I will fire up my ARTA setup for FFT testing, once I have all three amp boards running stable and partially optimized, and some time around that, I will make a stereo amp and actually connect some speakers.	blue LED 2,83V
2118 2120	**Should we be using blue led rather than ZD. Thought blue LEDs produced more noise.** **I'd use two Red LEDs, or a group of 1n4148**	 noise?
2122	I testing with up to 55v rails, but have settled on 35V rails for the moment. So far Amp#2 is looking the best: It seems to like 20-22mV Vq (Quiescent voltage). This gives the results shown in the two screenshots. At 1w level the distortion residual looks nice, almost a class A shape, clearly H2 dominant. Over about 6Vrms this changes though, and the distortion takes on a rather peculiar shape, which is new to me - I assume it is a quasi-mosfet trait. But at both 1w and 50w output (in 8ohm load), the THD stays around 0,08%. Raising the quiescent to around 50-60mV, gives a slight improvement up to 6Vrms, but above that is actually becomes worse than at the lower Vq. Then if I go very high on Quiescent, up to 180-200mV, it looks better at all power levels, but of course this level of idle power dissipation is not ideal. Amp#1 is somewhat surprisingly (to me), not performing that well. It needs more than double the Vq, and even so, the THD goes up near 0,4% at 50W. I would like to find out if this significant difference stems primarily from the Mosfet or the BJT, so will probably swap out the IRFP240 on Amp#1 for a IRFP250, and see what happens	THD, IRF250
2133, page 107	Finally built the higher power version of VSQC with **FQA40N25 mosfet and MJL4281AG bj**t output transistors. I have to say that it sounds just like the normal version with IRFP240 and MJL3281. Very good! I also used the led options at D9/D10 and D7 rather than zeners and diodes. The blue leds need a piece of electrical tape to avoid blinding me while setting up. **I'm running these at +-52VDC with 35mV bias across R20 (0.33 ohm) and the heatsinks do get warm, 47 C (117 F)**. Q3 is standing with no heatsink and is running about 55 C (131 F). The amps are built on DACZ boards and schematic in post 1231.	Hgih Power
2150	Prasi Layout	
2152	Thiago Layout	
2154	There was even a full power version which gave more than **100W using FQA40N25 Fairchild mosfet and MJL4315 from OnSemi - just two output devices - run from up to 56V rails.**	High Power 56V rail
	Prasi and other PCB's -gerber	
2157	https://www.diyaudio.com/community/threads/very-simple-quasi-complimentary-mosfet-amplifier.255427/page-108#post-5440830	
	#675 for Prasi Rev 4.3	
	#1627 for Phunk	
	#482 for one of Thiango's. If I remember correctly Thiango's PCB required some modifications.	
	#1354 for DACZ single-sided	
2158	#1964 and here is double sided PCB	
1964	https://www.diyaudio.com/community/threads/very-simple-quasi-complimentary-mosfet-amplifier.255427/page-99#post-5172427	
2172	BTW, any 150W nmos with 20A and 200V is all you need. Today **I bought 160 NXT (Philips) nmos in TO247, rated at 150V, 300W and 73A!!** They cost AUD70c EACH locally. They would be OK to replace the IRFP240, but of course you also need a pmos too, I suggest the FQA36P15.	
2176,2177	When I switch off though, I notice a **DC spike of 2.4DC at the speaker output**. This is tested no input or output loads connected. Would that be from the inductor? Is that going to be damaging for a speaker? No the **2.4v thump is normal, an artefact of the singleton input stage.**	
2184	This is HF oscillation; you can verify with the Zobel 10R at the output. If the Zobel resistor never heats during use however the amp is quite stable.	AKSA-if you touch mica 33p
2186	PWM fan controller	
2192	1.5uH should be even better from **oscillation** standpoint. There is a 47R and 220pF snubber between drain and gate trick that can sometimes help in these situations. These are used on the Alpha BB amp.	ocillation
2206	I ran a spice sim on the circuit with different options for cap C8. The circuit seems to be happy (in sim, anyway) with onwards of 67pf in this position. I think I put a 100pf as a standard value in my first 2 boards. (simmed with IRFP250 and 2SC5200).	C8 feedback Cap
2208 2215 2223 2225 2298	**Marc´s amp_fit into 2U, scheamtic**	
2219	Some good info here: Quasi Complementary Transistor Output | Radio-Electronics.Com https://www.electronics-notes.com/articles/analogue_circuits/transistor/darlington-sziklai-quasi-pseudo-complementary-pair.php And here How to identify a quasi-complementary amplifier? https://www.diyaudio.com/community/threads/how-to-identify-a-quasi-complementary-amplifier.162310/	read ybeout Quasi amps
2220	: why we cannot use a PNP transistor like the **MJW1302A** in this amplifie	
2248 2258	It's clear as tube guy...a load. Please look to added eagle schema from other Marc- only one green LED- that point should only go to 1,8-2V to set an offset, if i remind right. Thimios measurements are very careful done and shows another V point between Q6 Gate and Q5 Base- i have measured for own control 5,1V. Wonderful Marc, C1845 and 5551 have very different pinouts - good find, it is difficult to find pinouts issues. C1845 is a very good VAS I suggest you find one because they have very low Cob and high beta. Just arise from sleeping you are correct! **To get offset you must play with the led voltage reference. I would replace the single red led with two series 4148 diodes; that gives you 1.3V rather than 1.6V for re led and it should bring it up to 0mV offset.**	**DC offset**
2261	I have replaced the **two red led with 2N4148 as you suggested and I have been able to trim the offset down to few mV**	**DC offset**
2269	With 1.5k and 68R for fb network you have a gain of (1500+68)/68= 23. This should be OK for most digital sources. There is no requirement for using a 1W resistor at 1.5k, but there are some advantages using a carbon resistor, half watt is enough. Carbon resistors alter the harmonic profile of the output, and give a little more H2, like a tube amp which usually use carbon resistors too. If you want a bit more gain, say 32.9, you could decrease the shunt resistor from 68R down to 47R - or 56R for an intermediate gain of 27.8. No other changes to the amp if you do not change the 1k5 series fb resistor; changing this resistor will affect offset and may need different voltage references; red, or even green leds.	**gain**
2274	Yes, thanks Colin, that is the reference, #2246 on page 225. But note that schem indicates 32V rails, yours may be higher. What you really need are the bias points for the output stage, and the reference voltage for the input transistor base, shown here at -1.95V.	**all voltages DC**
2278	DC protection board by prasi	

2287	I have read in your **post 1795** this : "There is switching taking here; the diode, the resistor, and quasi. This switching causes higher harmonics. When you measure the 120/150 combo, you get this at +20dB output, attached as Ranchu120-150. When you measure the 150/150 combo, it's very similar here attached. I can actually see no reason to make these resistors, R19 and R14, different. They should be the same value; in this situation, I'd use 120R for both. In the FFTs, all quiescents were set to 125mA for correct comparison. You suggest to use 120R for both R14 and R19, but can I use 150R or 100R with similar result (I still haven't 120R in 0207 package) ?	
2290	What I have changed : 1) the 2N5551 replaced by the KSC1845 of course, my biggest error :bawling: 2) the two red LED replaced by two 1N4148 3) the 1.5k R9 by a 1.8k 4) the 150R R14 and the 120R R19 replaced by two 100R as suggested by Hugh 5) the IRFP240 by the **FQA40N25** (a big package !) 6) the 2SC5200 by the **MJL3281AG** 7) the 500R VR2 by a 1k 8) the 22uF C3 by a 47 uF	**marcs changes**
2296	If you have more **FQA40N25, give it atry for MoFo** with your Huy Preamp, my prefered MosFet there.	**MOFO**
page 115	https://www.diyaudio.com/community/threads/very-simple-quasi-complimentary-mosfet-amplifier.255427/page-115	
2298, 2299	**Marc´s small pcb for 2U gerber file, BOM and layout, correction for values in a file**	
2300	Marc´s protection board	
2305	In a quasi, the two output devices are used in dissimilar ways; one a source follower, and the bottom, a common emitter. This gives more second, third and fourth harmonic than a simple complementary output stage. If you still stay with a quasi, using a nmos as a source follower and a npn as an emitter follower again means both devices are used in dissimilar ways, BUT we add this difference even more with different devices. This even more accentuates the second, third and harmonic harmonics but distortion is no worse than two nmos, or npns in a same gender quasi. By using a npn as the inverting output device we reduce the headroom losses on the negative half cycle. With a nmos as quasi, the headroom loss of the negative half cycle is around 7V. Using a npn, this loss is reduced to about 4V. This increase of 4V is matched by a higher headroom limit on the source follower because it is driven by a bootstrap which can throw beyond the positive rail; so this really improves clip by 8Vpp. If you start with 42V rails, a clip limit of 34Vp, which is 72W. It this is improved to 38Vp, the clip limit is increased to 90W (both in 8R) so this is a huge increase of power output of 25%, something you cannot ignore because power supplies cost money. The harmonic profile is very good with a quasi, better than many complementary output stages.	AKSA
2309	I have made a very compact power supply C-R-C board for the quasi with the same dimension and they can be fixed on the heatsink too.	Marc´s CRC...bad version...read more..
2313	nicely done. just one suggestion. make the diode output go to smoothening caps and then connect the cap to the resistor. i.e. DC supply must be taken from cap terminals. 4th paragraph from last.Project 101 - High Power, High Fidelity Lateral MOSFET power amplifier Also you could consider adding transformer snubbers.**RingNot: power supply for chip amps. Bare PCBs and/or assembled+tested units** Go for 1st option of design, dual bridges alway lower noise.	prasis compact CRC for Chip amps
2324	Marc´s compact CRC corrected	Marc´s CRC...corrected version
2325	Marc´s new protection board	
2332	not finished pcb for protection	protection pcb new
2328	I have build the EL34 Baby Huey, see picture (EL34 Baby Huey Amplifier) that I like a lot because its particular feedback give a clear and solid sound without the softness some time associated with tube amplifier and I found the Quasi very similar in result for a **much lower cost (mainly because it does not require expensive output** transformers).	**Quasi vs. Tube amp**
2333	Marc´s mini CRC PSU gerber	
2337	You could have a look at UPC1237 chip also, now C1237HA. It can have over current protection and quick shut off, apart from initial start delay and dc protect. **As a last resort, to protect expensive speakers, you can take a look at crow bar protect circuit.** **Apex has one such design.** **Studio Reference Amplifier**	**protection baord**
		https://www.diyaudio.com/community/threads/studio-reference-amplifier.173462/page-111#post-4836119
2343	Have a look here too Marc. Speaker Turn On Delay and DC Protector Board Set (V3)	protection is good here.. lcpcb ordered
	Jhofland	https://www.diyaudio.com/community/threads/speaker-turn-on-delay-and-dc-protector-board-set-v3.247279/page-17#post-5607311
2350	Just to throw this out there, I use a protection board I found at DiyFan.com. It's based around the **uPC1237 IC.** It seems to work pretty well. Attached are the schematic and hook-up files and a picture of the one I just built. I have a few extra boards if you want one. Let me know.	protection pcb uP1237IC
2357	DC Protection 1 circuit . 30V DC trigger Triac and protect speaker if amplifier device fails 2. Circuit 8V DC trigger Triac and protect speaker if amplifier device fails If you have rail > 30V you can take circuit 1 because SBS 2n4992 for circuit 2 not easy to get need order by mouser , farnell ... circuit 1 devices easy to get Normally amps have Rails > 30V no need circuit 2 **THIS CIRCUITs works in any amplifier from 1W - 5000W** Its from PA, never I have lost speaker against DC since using crowbar	TRIAC protection pcb
2359	**Crowbar protection circuits are suitable only for amplifiers that using fuses on rail voltages** **Usually you still need relay or other circuit for noise free on an off.**	TRIAC protection pcb
2362	**RELAY CANT protect speaker if amplifier fails only crowbar can DO, if amp no have fuses POWER supply will destroyed / amp burning up** **but Crowbar will protect the speaker in this case**	TRIAC protection pcb
2383	Marc´s PCb for amp and CRC	
	coil calculator	
	http://www.circuits.dk/calculator_single_layer_aircore.htm	
2414	The 8dB NF is one deterrent. BC550/560 is 2dB. You can get lower still in single devices: 0.5dB 2SA1299 50V TO92, 1.5dB 2SA1190/C2855 (90V) 2SA1191/C2856 (120V), TO92 0.5nV/rt-Hz 2SA1083/84/85 /C2545/46/47 60/90/120V TO92 0.5dB 2SA979 100V SIP-5 dual diff-wired 0.5dB 2SA798 50V SIP-5 dual diff-wired	noise
2415	This was considered but high matching was important at low cost. In the final design a singleton KSA992 was used as I recall and the mechanical size issues precluded the SOT version for a single TO92. The original circuit is at #158 on page 16 of this thread.	
2417	**Set 45mV across the 0.33R resistor on the CRC. This will set around 125mA quiescent on the output stage. Then set the offset to set less than positive or negative 15mV at the hot output wrt ground. Check after half an hour idling, and reset again to be sure.**	**setup**

2427	**Offset is not tightly controlled on this amplifier and the reason many users like a servo.** **A servo is NOT needed however.** **Wait until the amp is warmed up, half an hour idling, then set the offset to 0mV -/+15mV. It will move up and down regularly according to thermal effects.** **Furthermore, the bias (quiescent) is dynamic and will change a little. Set it up warm, half an hour after idling, and accept that it will go up and down a little. Be sure that the Vbe multiplier, the BD139, is in thermal contact with one of the output devices. These changes are normal, transistors are extremely sensitive to temperature effects, but as it warms up the quiescent should drop a little. This is intended to cool off the amp should it become very hot under heavy use.**	**setup**
2431	You go to the core of the design. An engineer designs an amp for lowest THD. But THD is an aggregation - a sum - of ALL the harmonics in the distortion. Some distortions, however, sound very good, like second harmonic. A few do not like this, however, but generally in the minority. So I like to define which distortion is good (musical harmonics) and bad (electronic distortions which are objectionable, such as H5, H6 and pretty high higher orders). Conclusion: If THD is inevitable, it is best to remove as much H5 and beyond harmonics as we can whilst leaving, or even enhancing, H2 and H3 and maybe H4 too. With maths, it is possible to simulate which part of the THD is given to H2, H3 and H4. If that figure is over 99%, then the objectional harmonics might be 1% of the total THD. This could - and for me generally works - gives us measure of quality of a SS amplifier. Even order harmonic is created by asymmetrical distortions on the full waveform. That is, if we look at the CRO, the top of the wave may be wide, and the bottom of the wave may be narrow. That generally describes H2 and some H4. There will many harmonics in all the distortions analysis, and by M. Fourier (your math guy, thank you for him!) we can assemble a train of harmonics on LTSpice showing all the harmonics. What makes high levels of H2? Well, a big difference in transconductance between top and bottom outputs of a PP amplifier. If the mosfet is at the top, and bipolar at the bottom, the differences in gm are huge. Actually, since the upper and lower devices are used in different ways (upper is source follower, and bottom is common emitter) this gm difference is always 'built in', so H2 and H4 are enhanced anyway. More differences with difference devices, mosfet and npn, bring out this gm difference even more. This creates the H2 and H4 you hear in the Quasi, which is sweet, and rich. You hear the subliminal, psychomotor sounds of distortion. These are very low; H2 is around -45dB in a tube, but in the VSQ it's at -70dB, but the ear responds with 'warm'. This is my conclusion of 25 years designing amps but I have to tell you that a number of significant designers disagree very strongly with these ideas. That's good; progress is created by unreasonable people..... even if they are wrong, they highlight concepts which are understood in the conventional body of work.	AKSA -design VSQA
2450	hyvrid amp by marc- tube and MOSFET + protection	
	https://www.diyaudio.com/community/threads/simple-hybrid-tube-amplifier-with-mosfet-output.336532/	
2479	Sorry, my friend Marc (bandol83) died in november 2020.	
2481	Idefixes PCB	
2491	By chance I discover this circuit diagram. This I have see in a similar kind first time 11 years ago in a commercial amplifier from NAD - go to post #1+11 under New Push Pull Buffer Approach for special Kind of THD - MOSFET & BjT - New for me and NAD 310 - need some info What actually is the benefit for using a MOSFET in the upper half and a BjT power device in the lower half of the power output (buffer) stage (sorry - I haven't read the whole thread) ?	NAD 310 scheamtic
2513	Runs best at **a quiescent of 125ma.** Read through the thread and focus on construction.	bias 125mA
2562,2563	Link didn't go the correct place for me. Look to post 1354 Looks like the last Dacz PCB version is post #1964	different pcb
2564	Link was to post #2158. Post #1964 and #1354 also have images and files for the PCB.	
2570	**Silver micas** are selected for very high frequency performance. Here's the reason. Any **global feedback amplifier must be compensated** so it will not oscillate. This can happen when phase shift from front to back of the amplifier approaches 180 degrees, transforming negative fb into positive fb. This usually destroys the output stage of the amplifier, and often the speaker drivers, so it must be avoided at any cost. The trick is to drop the loop gain to below unity; if it is less than unity loop gain, positive feedback will not accelerate the input of the amp towards oscillation. On a SS amplifier this Unity Loop Gain Frequency (ULGF) happens around 500KHz to about one MHz, depending on the design and components. To reduce the loop gain (the 'excess' gain over the nominal 'closed' gain set by the fb resistive divider) we use a small cap from the voltage amplifier down to its input, or even the fb node. Usually this cap is strung between collector and base of the VAS. The cap must be temperature and frequency stable, and so we use silver mica. You can use COG and NPO ceramics, but I generally find the sound seems to be a bit better with silver mica. Books are written on compensating feedback amplifiers. It is a category of electronics called 'control theory' and applies to any device set up for gain using negative feedback. Control theory even applies to sugar levels in the human body, for example, it is ubiquitous.	AKSA-feedback cap-mica
2598	Can we end this confusion. jvhb I assume has built with the 10R 1W resistors that conform to what is shown on the Rev 2.0 schematic shown below for R22 and R25. The boards that I have are Rev 2.01 shown below and show 10R 2W resistors for R22 and R23. Thimios, I have not come across any literature or schematics that show using a 3W resistor in these two positions. Is this just your recommendation for extra safety.? jvhb, can you confirm you built with 1W resistors, then I will use one 10R 1W along with three 10R 2W resistors.	Thiele Network -Output
2604	This 10R resistor normally carries no dissipation. But, should there be some RFI around, or maybe you are testing it at 20KHz full power square wave, the dissipation will shoot up alarmingly. I normally use only a 1W resistor, but take some care to use a flameproof resistor and mount it 2mm above the pcb, so it won't fry it should it dissipate a lot of power. Together with the 100nF series cap it loads up the output at high frequency, improves the stability of the amplifier in the >200KHz area where the phase shift CAN, in some situations, take the amp into instability.	Thiele Network -Output
2663	I am having problems with both of the amp channels. I am describing below what I feel is the easiest problem to fix. I am having problems with adjusting the offset voltage below 2.0V. I have built as per the attached schematic and pcb board. I am having no problems with the setting the bias. If I remember correctly stillforgiven and xrk971 had these problems also. Not sure if changing the value of R5 is the way to solve this problem. I can also mention that I have no leds installed, only recommended diodes as per schematic. I have visually checked solder joints and as far as I can tell, components are installed correctly. I am using 200R trimmer to set offset voltage. 0.33R resistors R20 & R21 are underneath the boards. Please see attachments and thanks for any trouble shooting tips. Tried to keep wires out of the way to show components.	
2664	I was reading some of the threads (I have downloaded and edited a lot of them to remember important knowledge) concerning the use of led vs diodes. Xrk used only a blue led and did not populate D7 the 3V3 diode. No red led; used 2 1N4148 instead. This enabled Xrk to set the offset voltage to 2-3mV	DC offset
2667	Replace one of the diodes on the voltage reference offset network with a blue LED. **R5 should not be changed, it changes the feedback ratioes.**	DC offset
2668	i have kept this post by Hugh https://www.diyaudio.com/community/...imentary-mosfet-amplifier.255427/post-4796245 I have build it mostly that way But: Q1- 992; Q2-1845; Q3,5- 1381; C4-1000µ/16(better going as advised); R5-actual 100k; D7-3,3v zehner Thanks again to Hugh for claryfiing that important point about R5, i will change it too...if i start building again, all stopped since nearly two years now. Earlyer was refered about that reference LED- a green one (~1,6V) or 2 x 4148 string that should give ~1,3V. I hope i not confuse things now anymore. :oops: Hope you will figure out it.	DC offset

2671	To recap the concept, there is no change to the aim; to simply change the voltage reference for the input base transistor. **If you have +2V offset, you have to put 2V MORE negative on the base voltage of T1, and this means playing with the drop across the two diodes, nothing more. Any change to R5 affects feedback, a definite no.** Because of stacking tolerances on this amp (hfe and Vbe of T1) it is difficult to ensure that the offset control pot will always be in the center, so some adjustment is needed.	DC offset
2673	If you have +2V offset at the output, then we need to add 2V NEGATIVE to the bias resistor, R5. D9 and D10 pass about 4mA, and drop around 1.4V. We need to increase this drop to 1.4+2=3.4V. Easiest way to do this is remove BOTH the diodes, which drop 1.4V, and replace with an LED which drops close to 3.4V. The optimal LED is a blue, as they drop about 3.3V, close enough for government work here! OR, you could drop ONE of the diodes, and replace with a green LED which drops 1.95V, so this will add 1.25V, not quite enough. We have to get to 3.4V, and the best is a blue LED. R5 is the bias resistor of the base of T1, and if you change it you change the input impedance of the amp which could be problematic for the source. Best to leave it at 33k, which sets the Zin of around 25k, easy to drive.	DC offset
2680	I would replace R6 10k for a 15k Then replace the trimmer **with 500R version.** **I was not aware you using a 200R trim pot.** This will reduce LED current from 4ma to 2.7ma and reduce its drop from 3.3V to 3.1V. This should fix the offset issue.	DC offset
2687	**XRK with different sound clips**	https://www.diyaudio.com/community/threads/virtual-audition-of-very-simple-quasi-mosfet-amp.295286/
2701	**Big Quasi**	
2704	Your requested Lazarus returns!` It will do 100W into 8R and almost double into 4R, but watch out, **the weak link is the C5200 quasi and should be doubled for a four ohm load, and a FQA40N25 higher rated nmos for M1 for lower impedance loads.**	
2713	It is quite cheap to get some PCBs made and shipped using the gerbers posted in the thread. Usually postage is the part that costs the most, but can be very cheap if you are prepared to wait for slow-mail. **There are a few PCB versions to choose from:** **Post 2157** **Post 2154** I have been using the Phunk 'Borg' on and off for some time now and it's been a solid performer.	