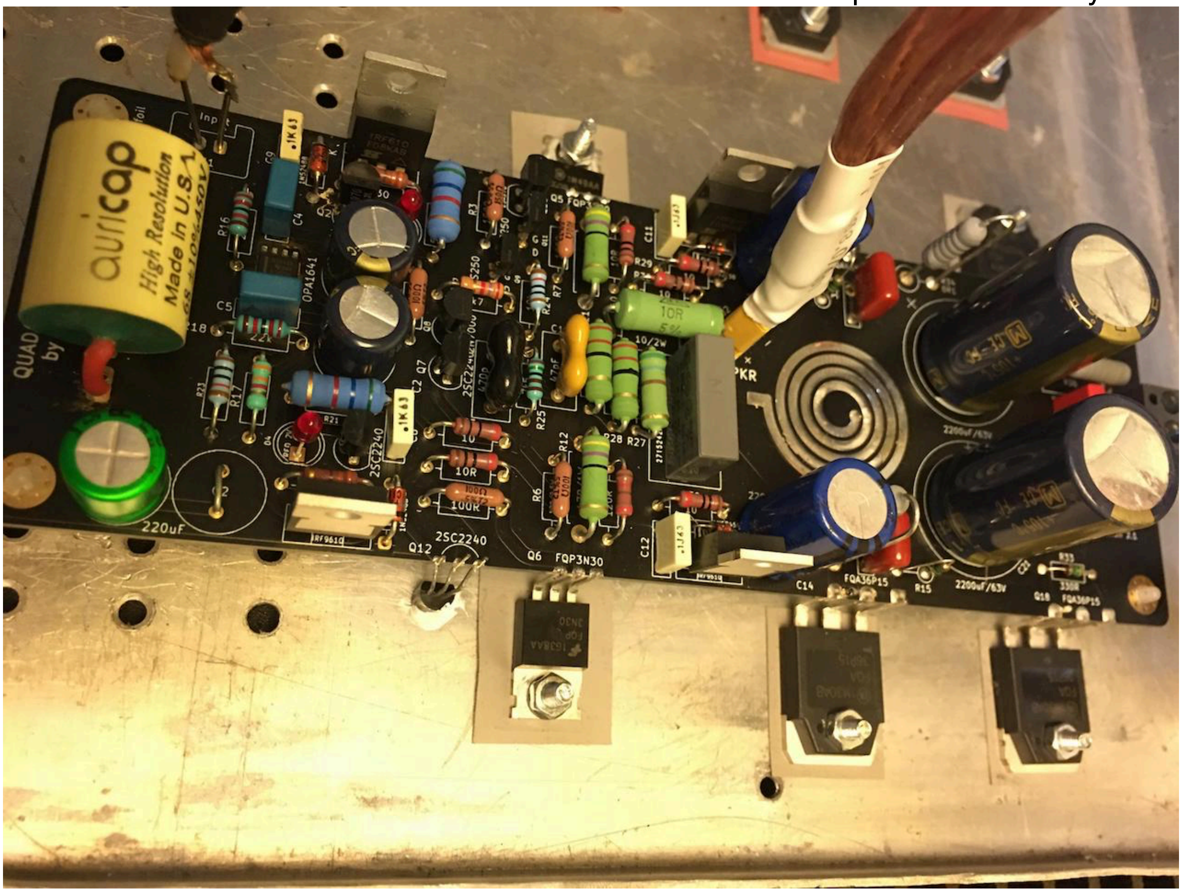
Q17 - audiophile approach to perfect sound

Hard to prove statements:
I know what I saw ! Ufologist
I know what I hear ! Audiophile

by audiophile Tiberiu Vicol
This document was updated on 21.May.2022

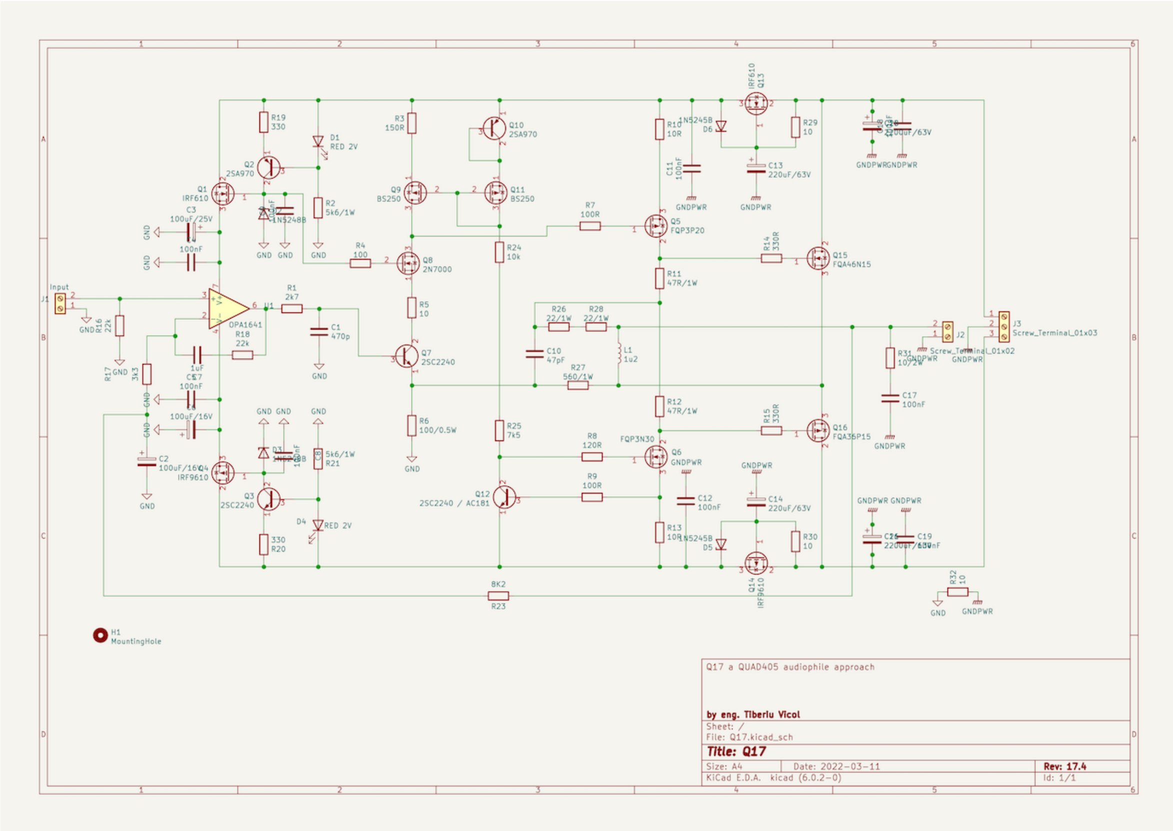


Introduction
Q17 is a class B amplifier based on current dumping principle.

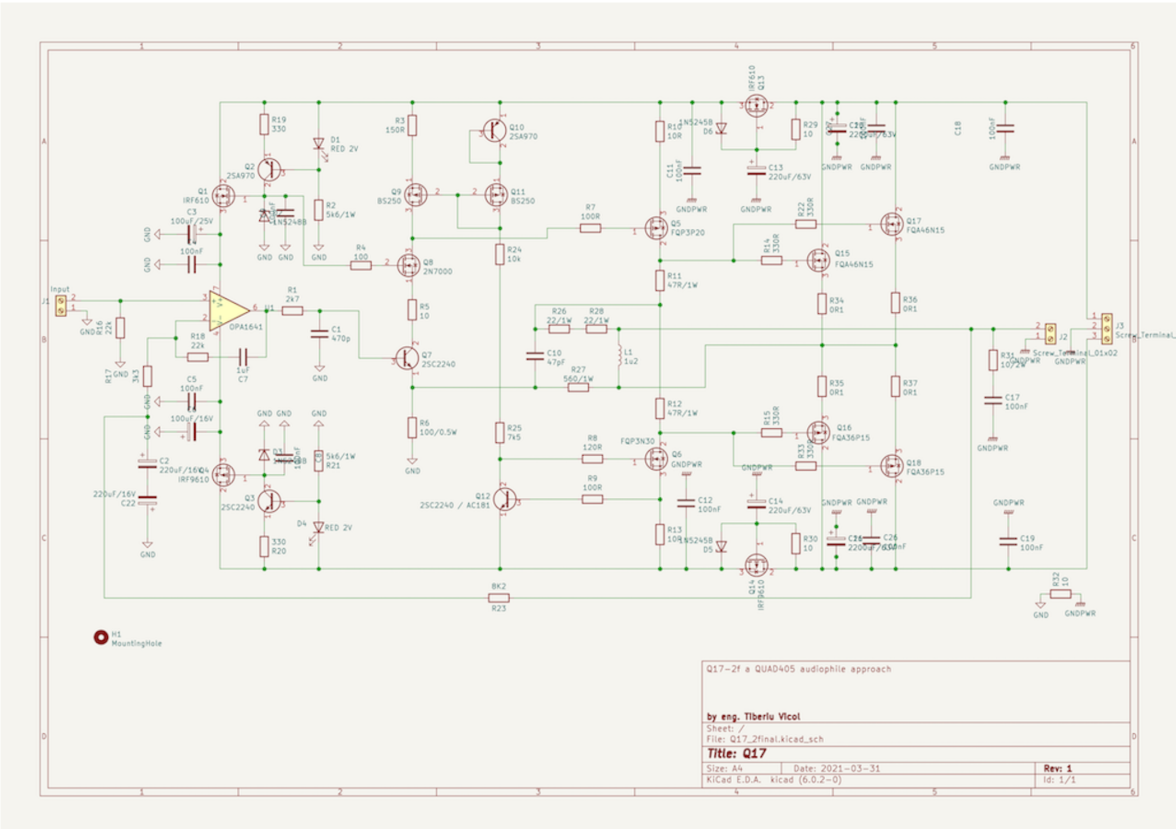
Initial technical requirements:
- stable operation. Amplifier must be stable in any operation condition. No oscillation at any frequency.
- 100W in 8ohm at 1kHz. This should be enough for an audiophile as long his “impossible to drive” speakers are moving.
- frequency response cutoff 10Hz - 100kHz. This will allow a decent slew-rate as well.
- IMD inter modulation distortion under 0.01%
- THD total harmonic distortion under 0.01% @ 1W&full power
- design must be affordable, with relatively easy to find components and equivalents THT or SMD.
- cost effective and easy to build. High-end audio must be affordable.
- open source. Let’s offer all, schematic, simulation, source pcb files and bill of materials.

- designed by using LTspice simulation with final touch by extensive bench measurements and testing. Starting with KiCad 6.0.2 ngspice simulation is possible and files have been made available by Holger Vogt
https://forum.kicad.info/t/simulation-examples-for-icad-eeschema-ngspice/34443
- final design decision are always my platinum ears. ;-) This mean Q17 is designed by comparing different topologies and final decision is taken, not by measurement, but by listening. Q17 is indeed designed by ear. :-D

And here are on-ear requirements:
Sound is paramount. It must sound very good, at any level. There must be no listening fatigue. Sound must be vivid, full body, plenty of harmonics with long decay, while keeping resolution and clarity from top to bottom. Each instrument must sound natural, clearly separated and easy to locate in space even in large, big band orchestra.
- no hiss no buzz. Poor rectification and filtering may lead to unwanted noise.
- micro dynamic. Yea, this is the hard thing. My foot must beat the rhythm at any level. I do not want flat, compressed and dead sound. This is often collaborated with negative feedback - NFB. In my opinion it is partially true and highly depend on how you use NFB and other things. Good quality power supply filter capacitors may help as well.
- macro dynamic linearity. Amplifier must be able to go from low level to top power in an instant and to keep that high power level without distortion and compression. It must give the sensation of unlimited power. This is mainly related to power supply. If amplifier is capable to deliver, power supply must cope as well.
- resolution. I like an amplifier that offer resolution and full body instruments, without loosing harmonics and decay. Well designed SEDHT (single ended direct heated triodes) are able to do this and I want same from my amplifier too. I know is another hard one. :-) Inter modulation distortion have a word to say here. Low IMD always lead to top resolution, but sometimes musicality is lost.



Q17 with output single pair of Fairchild's



Q17 with output double pair of Fairchild's

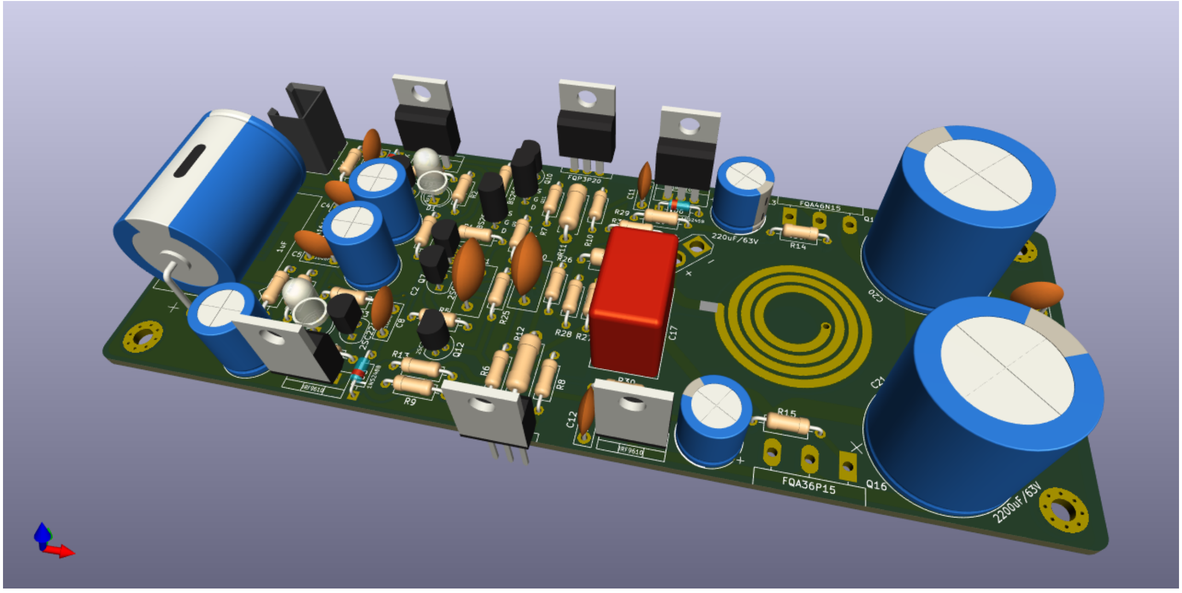
Functional description
Q17 is designed to deliver music at highest audio performance and this design do not follow "amplifier design book". Intentionally input is dc coupled, it has no input LPF and do not make use of diodes or Vbs multiplier for thermal compensation.
Q17 will run in class B, even output devices are mosfet with very high Vgs threshold. As far I know this was never attempted, please correct me if I'm wrong.
Q17 is divided in two separate sections. Let's called section one and section two. Section one is made with operational amplifier OPA1641.
Today, OPA1641 is one of the best opamps on the market. In fact is so good that a discrete circuitry will barely come close. OPA1641 is a JFET input operational that apart technical specifications, sound very good and is cost effective too. We are not driving a low impedance output and there are not thermal issues.
Those who do not like JFET sound, may try LME49990. This sound great as well. IMHO phase accurate it is very important, therefore Q17 is not-inverted and will preserve original phase of the signal.
Input impedance is given by R16 = 22K. This is a good trade between high impedance and thermal resistor noise. You wanna higher input impedance? You can go as high as 47K. Use here a good metal foil resistor and should be enough.
R17 and R18 are part of operational negative reaction and will set the gain to (R17+R18)/R17=7,6. Many operational amplifiers will not be stable at low gain and the stability limit is usually at gain higher than 5. 7,6 will offer good sensibility and we are on the safe side, away from any oscillation.
Trough R30, R25 and C3 input operational will have a second role acting as DC servo. C3 must be bipolar and I recommend to use a good one like Nichicon MUSE. However, two normal polarised electrolytic's connected in series will work just fine. For this use low voltage electrolytic's in range of 6,3V - 10Vdc.
R1C1 form a low pass filter with cut off frequency at 125kHz. This RC filter is the main load for the operational and will also limit whole amplifier full bandwidth. C1 must be silver-mica or polystyrene.
Operational is feed by two "reasonable low noise" regulators.
Operational will not draw more than 10mA per raw, but his sonic performance is highly dependent on the quality of these regulators, so I have invested some time and parts to get the best topology for sound versus price compromise.
Here is how it works.
Regulation is ensured by 18V zener's, D2 and D3, which are feed by a constant current source at a ~4,2mA.
Q2,D1,R19 and R2 (respectively Q3,D4,R20 and R21, for negative rail) form a simple current current source. D1 and D4 are red LED with Vf~2V. It is well known that LED is a reliable low noise voltage reference. Current trough zener diode will be (LedVf-Q7Vbe)/R19=(2-0,6)/330=4,2mA. This reference voltage is used by two mosfet Q1 respectively Q4 to deliver higher current to OPA1641. IRF610/IRF9610 are a bit overkill here, but are easy available and cheap enough. These will run warm, but do not heed a heatsink.
Here is one of my first audiophile observation: MOSFET regulators sound better than bipolar. Do not measure better, sound better.

Section two start with a cascode formed by Q7 and Q8. This stage offer high gain, high output impedance and high open loop bandwidth and may be a challenge to keep it out of oscillation. For this reason R5 is there. This will lower the gain and

increase stability at the cost of some distortion. In place of Q7 some inexpensive transistors BC5xx/BC8xx can be used ,as maxVce> 45V is the only restriction. From sonic point of view, some cascodes may kill the “soul of music”, in other words, offer a less vivid sound. Things are going far better if you use a mosfet as top active device. This will preserve dynamics at any level.
Cascode- Q7&Q8 - stage have high output impedance, therefore is feed by a constant current source made by Q10 and R3 at aprox. 4,5mA. Q10 can be any low cost, high beta pnp bjt. Yes, any pnp, no constraints.
The CCS current is mirrored to Q12 by Q9&Q11 trough R24&R25. In fact the heart of Q17 is around this CCS+ current mirror. Current mirror that can be made with high beta pnp transistors, or p channel mosfet.
I tried both. BJT mirror is very precise and offer a lush sound. For mosfet I used BS250P and in this case sound is dipper with a better midrange. Micro-dynamics seems to be higher too. After extensive listening sessions and some burn-in, I can confidently say that I will stay with mosfet mirror. Take care on BS250P numbering termination, as this is different on manufacturers - see Vishay and Diodes.
Instead R24&R25 you may use a single 1W resistor. This was split in two in order to distribute power dissipated.
Next is class A stage. Here a single modern high transconductance mosfet will do an execelent job, at the cost of some input capacitance. Mosfet's do create more even order harmonics compared to bipolar's too. As I care more about harmonics content than THD, here is my preference for mosfet.
The quality of these MOSFETs may dramatically influence amplifier sonic signature and these have been chosen after long listening sessions.
P channel MOS Q5 is class A active device and from my observation, P channel FQP3P20, is slightly more linear than N channel FQP3N30. Anyhow, at current time - 2021 - we do not have too many options. Toshiba’s lateral mosfet’s (2SJ76, 2SJ77, 2SJ78, 2SJ79 respectively 2SK213, 2SK214, 2SK215, 2SK216) are long time obsolete. If you can source them, use them, but don’t put your expectations high. These will not sonically exceed FQP’s. Hovever, if you do, some capacitor compensation it may be needed, in order to keep them out of any oscillation. Q5 is feed by a 60mA CCS formed by Q12 and Q6. Q12 Vbe is the main reference in this CCS and can be used as thermal compensation for final stage, too. Again, no constraints for Q12. Can be any high beta, low voltage, npn bjt. CCS current can be calculated by Q12Vbe/R13 and would be around 60mA. This will push Q5 operation in class A and offer enough juice to drive final dumper stage. Q5 and Q6 will dissipate 3W and must be mounted on heatsink.
Q12 must be mounted on heatsink too, as it will be used to compensate final stage thermal runaway.
Changing R13 to 2ohm, a germanium AC181 can be used here as a better temperature compensation. I must mention that this mod will not bring “germanium sound” into this amplifier. Sorry, germanium lovers !
R9 is there as base stopper and to avoid any possible oscillation. R7 and R8 are gate stoppers too.
Q17 amplifier runs in class B. There is no bias needed and Q17 amplifier may accept a very wide range of output mosfet transistors.
Choosing final pair Q15 & Q16.
I’m a big fan of lateral mosfets made by Semelab-Semefab-Exicon-Magnatec, whatever company is behind. This Scottish company is one of the last to make very good high power lateral mosfets. I proudly used them in many Quasar amplifiers and

they sound exceptional. The main goal of Q17 is to be affordable and these laterals, as many other good things, are not so cheap. They are very rugged and allow high level of "torture" and make things sometimes easy. No protections needed. But … there is a "but". They have small transconductance. You need to use double die and parallel few of them to get some decent transconductance, because audiophile speakers make use of complicated crossovers who like lot of current in the most unexpected frequencies.
Fairchild, now ON-Semiconductor, was a great company and one of their legacy is FQA46N15 and FQA36P15. If you think these are P/N pairs, you are wrong. There is no such P/N perfect match in real world, but we can choose the most closed ones. These are marketed as: "Fairchild Semiconductor's proprietary planar stripe and DMOS technology.", with a small remark that these may be suitable for "audio amplifier" as well.
FQA46N15 have a regular transconductance of 36 Siemens while Exicon duble die ECW20N20 have a maximum of 4 Siemens. This is equivalent of 9 double die laterals. Yes, very impressive !
FQA36P15 have a regular transconductance of 19.5 Siemens while Exicon duble die ECW20P20 have a maximum of 4 Siemens. This is equivalent of 4 double die laterals.
In the "darkside" of Mouser are living some beasts that may leave these Fairchild's in dust. These are made by IXYS and a pair could be IXFK220N20X3 and IXTK120P20T. These exhibit over 120 Siemens transconductance and are able to transform your amplifier into a real welding machine. No joke at all. If your speakers have never been moved before, use a pair of these and shake your world, your walls, your neighbour …
Trough R11 and R12 will bias these devices near to class A operation. Both, FQA46N15 & FQA36P15 Vgs - threshold voltage between 3V and 4V. I found that P channel FQA36P15 will open around 3V, while the FQA46N15 will need 100mV-300mV more. (To have both running at same level R11 may be increased to 51ohm or more.)
Obviously Q15 and Q16 must be mounted on a large heatsink.
R31C17 is the well known Zobel filter. C17 quality is important. Use a good propylene here, or a polystyrene one. My preference is polystyrene Multicap RTX series. If you do not wanna invest too much go for Arcotronix.
R26,R27.R28,C10,L1 form current dumping bridge. R27&R6 are part of section 2 negative feedback. This set entire amplifier gain to [(R17+R18)/R17]x[{R27+R6)/R6]=45,6, enough for amplifier to reach 100W/8ohm at 0.7V input.
Q13 and Q14 are capacitor multipliers and are there to reduce power supply ripple. (These are not needed if you use synchronous rectification - see below.) During power on, the gate to source voltage on Q13 and Q14 may easily exceed 10V and may damage these mosfets, for this reason D5 and D6 are there to protect.
You may noticed that there are R4,R7,R8,R9,R14,R15 as gate or base stoppers. I always prefer gate stoppers than compensating with capacitors.
R32 will separate signal ground plane from power ground plane. No special requirements for this one.

PCB design



During “covid-19 lockdown” I had enough time to learn KiCad. KiCad run on any operating system and is open source. This offer flexibility, scalability and security. KiCad is a great tool.
I have designed this project in KiCad 5.99-nightly. To open files, you need at least 5.99. This is already compatible with upcoming KiCad 6, which is a huge step forward.
I opted for separate small and high signal ground planes. Ground planes are a good solution to avoid ground loops and offer excellent EMI reduction. For best noise reduction, small signal GND make use of top and bottom ground plane.
PCB embeds L1 inductor that is part of error correction bridge. This will ensure good tolerance and optimal geometric design. Yes, a PCB inductor will have the right shape for a near to ideal inductor. The truth is that I’m lazy to wire-wind coils. Having this embedded in PCB will help lazy people like me a lot, but what I said earlier is valid. PCB coil is better. In a separate document I have detailed on how to create and embed inductors in KiCad.
PCB offer the option to install several C7 types. Use propylene at any voltage > 50V. C17 must be propylene, preferably FKP, or polystyrene at voltage > 100V.
OPA1641 is the single SMD part and PCB do not offer the option to install a THT one, but as long I offer the source files for this project, you are invited to modify and redesign as you wish.

Bill of materials for Q17

D1,4 - LED RED 2V - https://ro.mouser.com/ProductDetail/Vishay-Semiconductors/TLHR5200?qs=GMckgg3bfZPthGr1cDR0RA%3D%3D
D2,3 - 1N5248B - https://ro.mouser.com/ProductDetail/ON-Semiconductor-Fairchild/1N5248B?qs=G5AQjGfRJcJY58VFTX%252BkdQ%3D%3D
D5,6 - 1N5245 - https://ro.mouser.com/ProductDetail/ON-Semiconductor-Fairchild/1N5245BTR?qs=jumAldekxNAufOthuRVeGQ%3D%3D
Q7,12 - KSC1845 - https://ro.mouser.com/ProductDetail/ON-Semiconductor-Fairchild/KSC1845FTA?qs=UMEuL5FsraDCmxWozTypUA%3D%3D
Q8 - 2N7000 - https://ro.mouser.com/ProductDetail/ON-Semiconductor-Fairchild/2N7000TA?qs=iN0KuJO79KZfCWVKA48bEg%3D%3D
Q2,Q10 - KSA992 - https://ro.mouser.com/ProductDetail/ON-Semiconductor-

Fairchild/KSA992FBTA?qs=BiJXFBt7cx0C7PSFUPmr1w%3D%3D
Q9,11 - BS250P - https://ro.mouser.com/ProductDetail/Diodes-Incorporated/BS250P?qs=OlC7AqGiEDnRUFCQhRDfhA%3D%3D
Q1,13 - IRF610 - https://ro.mouser.com/ProductDetail/Vishay-Siliconix/IRF610PBF-BE3?qs=%2Fha2pyFadugbZUitPAu%252BTEPjT5SopLZ8qDnf9IMIvY8%3D
Q4,14 - IRF9610 - https://ro.mouser.com/ProductDetail/Vishay-Semiconductors/IRF9610PBF?qs=cval6ThkwxtWoLkQbU%2FdsA%3D%3D
Q5 - FQP3P20 - https://ro.mouser.com/ProductDetail/onsemi-Fairchild/FQP3P20?qs=mdiO5HdF0Ki1WoTNCOatYg%3D%3D
Q6 - FQP3N30 - https://ro.mouser.com/ProductDetail/onsemi-Fairchild/FQP3N30?qs=FOlmdCx%252BAA1dVHDhvU%252BUcw%3D%3D
Q15 - FQA46N15 - https://ro.mouser.com/ProductDetail/ON-Semiconductor-Fairchild/FQA46N15?qs=%2Fha2pyFaduimCeOyuw0xouriGUKJcVVjoz%2FqQ0BKQtc%3D
Q16 - FQA36P15 - https://ro.mouser.com/ProductDetail/ON-Semiconductor-Fairchild/FQA36P15?qs=%2Fha2pyFadugPFcM3hvKrsP2cJsnMpKcpv1XDSGf5JCo%3D
U1 - OPA1641 - https://ro.mouser.com/ProductDetail/Texas-Instruments/OPA1641AIDR?qs=sGAEpiMZZMutXGli8Ay4kFRPeV04IrZfqfNgaiEGnmE%3D

C17 - 100nF - https://ro.mouser.com/ProductDetail/KEMET/R76MI31005050J?qs=pUKx8fyJudAaVipAdJ8Rqw%3D%3D
C4,5,8,9,11,12,18,19 - 100nF - https://ro.mouser.com/ProductDetail/KEMET/PHE426DJ6100JR05?qs=PoZJcSwa6DzVkLIswxOBtw%3D%3D
C10 - 47pF - https://ro.mouser.com/ProductDetail/Cornell-Dubilier-CDE/CD15ED470JO3?qs=JlSiUoO6twmzsCndHIj%2FhA%3D%3D
C7 - 1uF - https://ro.mouser.com/ProductDetail/Cornell-Dubilier-CDE/930C1W1K-F?qs=oi6qnwyrdkzUKQFAck35kQ%3D%3D
C1 - 470pF - https://ro.mouser.com/ProductDetail/Cornell-Dubilier-CDE/CD15FD471JO3F?qs=FKrQhPEeH%252B6Y%2FhdJiMfeDw%3D%3D
C2 - 100uF BP - https://ro.mouser.com/ProductDetail/Nichicon/UES1C101MPM1TD?qs=JgOBn5pVFoqelxyCFlUB6Q%3D%3D
C3,6 - 100uF/25V - https://ro.mouser.com/ProductDetail/Vishay-Sprague/510DX107M025CC2D?qs=j9BvaggtyN3XWy0%2FfD7iig%3D%3D
C13,14 - 220uF/63V - https://ro.mouser.com/ProductDetail/Vishay-BC-Components/MAL215058221E3?qs=sGAEpiMZZMvwFf0viD3Y3Yd5qvTVv7orMyRFoicAYcg%3D
C15,16,20,21 - 2200uF/63V - https://ro.mouser.com/ProductDetail/Nichicon/UPW1J222MHD?qs=sGAEpiMZZMvwFf0viD3Y3V%252BktQc2dZjNU8%252BcKz5%2FjOU%3D

R1 - 2k7 - https://ro.mouser.com/ProductDetail/Vishay-Dale/CCF072K70JKE36?qs=QKEOZdL6EQrf8lXj1m%2FHqg%3D%3D
R2,21 - 5k6 - https://ro.mouser.com/ProductDetail/Vishay-BC-Components/PR01000105601JR500?qs=LCMWAU1DZcyMK8Yz0ZAhmQ%3D%3D
R24 - 10k - https://ro.mouser.com/ProductDetail/Vishay-Beyschlag/MBB02070C1002FRP00?qs=Jr4%2Ft4s12JUmAfKOFUNhig%3D%3D
R3 - 150ohm - https://ro.mouser.com/ProductDetail/Vishay-Dale/CCF07150RJKE36?qs=Ad%252BIW%2FmDqmUeNbXSTmV5ZQ%3D%3D
R5,10,13,29,30,32 - 10ohm - https://ro.mouser.com/ProductDetail/Vishay-Dale/CCF0710R0GKE36?qs=QKEOZdL6EQpP4bkfADZzbQ%3D%3D

R4,6,7,9 - 100ohm - https://ro.mouser.com/ProductDetail/Vishay-Dale/CCF07100RJKE36?qs=NQWA6AwZmkMW4UI%252BG32rNg%3D%3D
R8 - 120ohm - https://ro.mouser.com/ProductDetail/Vishay-Dale/CCF07120RGKE36?qs=QKEOZdL6EQrffKbi7vq1lg%3D%3D
R11,12 - 47ohm/2W - https://ro.mouser.com/ProductDetail/Vishay-Dale/CCF0247R0JKE36?qs=QKEOZdL6EQqc7KTqtOG%2FUA%3D%3D
R16,18 - 22k - https://ro.mouser.com/ProductDetail/Vishay-Dale/CCF0722K0JKE36?qs=Ad%252BIW%2FmDqmUs0WVMJaSusw%3D%3D
R17 - 3K3 - https://ro.mouser.com/ProductDetail/Vishay-Dale/CCF073K30GKE36?qs=QKEOZdL6EQqcBZBx6GnZnQ%3D%3D
R14,15,19,20,22 - 330ohm - https://ro.mouser.com/ProductDetail/Vishay-Dale/CCF07330RJKE36?qs=pkalMaiJWwv10%252BO%252BONxDWg%3D%3D
R25 - 7K5 - https://ro.mouser.com/ProductDetail/Vishay-Dale/CCF077K50GKE36?qs=QKEOZdL6EQqRpabQIgr10Q%3D%3D
R23 - 8K2 - https://ro.mouser.com/ProductDetail/Vishay-Dale/CCF078K20GKE36?qs=QKEOZdL6EQrGlLmaSP0G2w%3D%3D
R31 - 10ohm/2W - https://ro.mouser.com/ProductDetail/TE-Connectivity-Neohm/RR02J10RTB?qs=s1WWODT2SXW%252BZIrISq22ow%3D%3D
R26,28 - 22ohm - https://ro.mouser.com/ProductDetail/Vishay-Beyschlag/MBB02070C2209FCT00?qs=sGAEpiMZZMsPqMdJzcrNwkfQgWkDJ%252BE2Mwj0n7JK2mo%3D
R27 - 560ohm/1W - https://ro.mouser.com/ProductDetail/Ohmite/OM5615E-R58?qs=sGAEpiMZZMukHu%252BjC5l7YREnR%2FWY87i1xVQq21Ltfa0%3D

J1 - input connector - https://www.hz-profishop.com/product_info.php?info=p701_mks-1651-6-0-202-s18--schwarz-.html
J2 - speaker output connector- https://ro.mouser.com/ProductDetail/DFRobot/FIT0586?qs=w%2Fv1CP2dgqouWR8IxqIK1w%3D%3D
J3 - terminal block x 3 - https://ro.mouser.com/ProductDetail/Amphenol/TC0303620000G?qs=Mv7BduZupUgRMrlfdnWHCQ%3D%3D

Extra parts for Q17-2f (Q17 amplifier with two output pairs)
R22, R33 - 330ohm https://ro.mouser.com/ProductDetail/Vishay-Dale/CCF07330RJKE36?qs=pkalMaiJWwv10%252BO%252BONxDWg%3D%3D
R34,35,36,37 - 0.1ohm/3W https://ro.mouser.com/ProductDetail/TE-Connectivity-Holsworthy/ROX3SJR10?qs=sGAEpiMZZMsPqMdJzcrNwtkiCP%2FuZm62WDIB0kikdgI%3D
Q17 - FQA46N15 - https://ro.mouser.com/ProductDetail/ON-Semiconductor-Fairchild/FQA46N15?qs=%2Fha2pyFaduimCeOyuw0xouriGUKJcVVjoz%2FqQ0BKQtc%3D
Q18 - FQA36P15 - https://ro.mouser.com/ProductDetail/ON-Semiconductor-Fairchild/FQA36P15?qs=%2Fha2pyFadugPFcM3hvKrsP2cJsnMpKcpv1XDSGf5JCo%3D

Active power supply

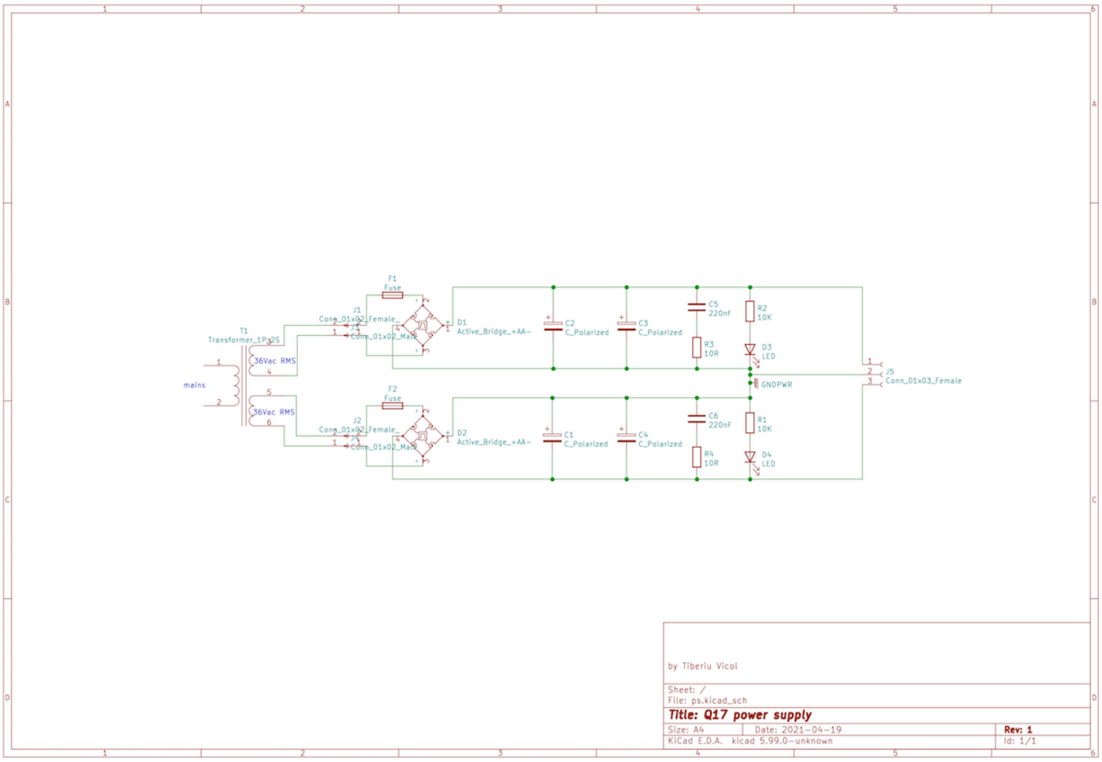
A good amplifier need an exceptional power supply. All design effort will be lost if we do not excel in this area too.

Diode is far for being a perfect device. There are not better devices but better solutions.

Synchronous, or active rectification was long time available in professional appliances. The very first synchronous rectifier (mechanical rectifier) had been used in 1950’s in high power and high voltage applications.

His limited usage in consumer was due complexity and very high cost involved. In

the last years, thanks to green power requirements and electric vehicles, several dedicated chips appeared in consumer market. These manly target PoE - power over ethernet, but by choosing right parts around the application can be extended to high-end audio as well.
Synchronous rectifier is a diode-less bridge employing modern mosfet transistors, that replaces the four diodes in a full-wave bridge rectifier with a mili-ohm Rdson MOSFET, to drastically reduce power dissipation, heat generation, voltage loss and diode on/off switching noise. There is no P-N junction involved, only a low miliohm conductive channel get inserted in power path. This allow big current capability, better power management, less power loss, less dynamic impedance change versus load current and better circuit performance than any available junction rectifier solution.



The advantage of using synchronous rectification is huge.
While a normal diode have at least 600mV drop at 1A, a low Rdson MOSFET will have as little as 3mV, or less, at same 1A. This is 200 times better than a PN diode and at least 100 times better than a Schottky diode.
But how is this translated in audio ? The most sensible difference is noise, due synchronous rectifier have less ripple and on/off noise. Each bridge mosfet is acting like a soft on/off switch. Entire medium to top spectrum is cleaner. Voices are soft and cymbals full of harmonics. Another effect is better dynamic. The sound is more vivid due no power is loss in rectifier, or modulated by diode pn junction and the single current limiter is intrinsic transformer resistance.
We make use of two Saligny Standard synchronous rectifiers, made by Evotronix SRL. These are operated at 36Vac, each, from a 300VA R-Core transformer.
C1,C2,C3,C4=10000uF/63V are main capacitor filters. There is a snubber formed with R3C5 and R4C6. This is needed only when normal diode bridge rectifiers are

used, in our case with Saligny rectifiers you may skip these parts. R2D3 and R1D4 are rail power indicators. A single power supply may be used for both Q17 modules, or two in case of a dual mono approach.

Bill of materials for power supply

J1,2 - terminal block x 2 - https://ro.mouser.com/ProductDetail/Amphenol/TC0203620000G?qs=%2Fha2pyFaduhbuFfD6OHbCYxDpT0ma2Hwq0r2vPcUv6eC%2FIlp4URn7Q%3D%3D
J5,6 - terminal block x 3 - https://ro.mouser.com/ProductDetail/Amphenol/TC0303620000G?qs=Mv7BduZupUgRMrlfdnWHCQ%3D%3D
C1,2,3,4 - 10.000uF/63V - https://ro.mouser.com/ProductDetail/EPCOS-TDK/B41231A8109M000?qs=f4aWRLuQiuxqY40YlReJiQ%3D%3D
C5,6 - 220nF MKP - https://ro.mouser.com/ProductDetail/CDE-Illinois-Capacitor/MPX224K305E?qs=HXFqYaX1Q2wK3o1vUzHyKw%3D%3D
D1,2 - Synchronous Bridge - Saligny Standard - evotronix.eu
D3 - Red LED - https://ro.mouser.com/ProductDetail/Vishay-Semiconductors/TLHR5200?qs=GMckgg3bfZPthGr1cDR0RA%3D%3D
D4 - Green LED - https://ro.mouser.com/ProductDetail/Vishay-Semiconductors/TLHG5200?qs=%2Fha2pyFadujruHm0H%252By%2FYe3hostfbxme%2F774XrUw9tU%3D
R1,2 - - 10K/0,5W - https://ro.mouser.com/ProductDetail/Vishay-BC-Components/SFR16S0001002JA500?qs=H30XFsNYD%2FGypwPt5jX7ew%3D%3D
R3,4 - - 0 ohm - strap these if you use Saligny Standard
F1,2 - fuse holder - https://ro.mouser.com/ProductDetail/Littelfuse/0PTF0078P?qs=Co4VkB5J4%2Fsczy6gG8s%2FsA%3D%3D
Transformer - *primary 2 x 115Vac region dependant* - secondary 36Vac + 36Vac at 5A

Selecting alternative parts

With current component shortage, it may happen that some parts listed in BOM to be unavailable, here are few alternative recommendations:
R16 - use a metal film resistor
C7 - use a good polypropylene made by Mundorf, Epcos, Vishay, CDC,
U1 - following opamps can be used and will offer different sonic signatures: LME49710, LME49990, OPA604, OPA134, NE5534. Do not use TL071, TL081, LM301, LM741.
Q2 and Q3 - use transistors with Vce >= 65V & hFE>=100 : 2N5401 / 2N5551
Q7 and Q12 - other transistors that may be used are: KSC1845, 2N4401, BC546 / BC547 / BC548 / BC549 / BC550 - use the one with A termination for Q7 and C termination for Q12.
C1 - this must be silver-mica or at least polystyrene.
Q1- KSA992, 2N4403, BC556C, BC557C, BC558C, BC559C, and BC560C
C10 - silver-mica or ceramic NP0
R26, R27, R28 - these must be non-inductive resistors. MILLS make some good ones.
C17 - in this order: polystyrene, teflon, foil polypropilene, metalised polypropylene.
Q5 and Q6 - following pairs may be used with excellent performance: FQP3P50/

FQP4N80; FQP4P40/FQP5N60
Q5 and Q6 - following pairs may be used with modest performance: IRF610/IRF9610; IRF640/IRF9640; 2SJ76, 2SJ77, 2SJ78, 2SJ79 respectively 2SK213, 2SK214, 2SK215, 2SK216.
Q15,Q16,Q17,Q18 - following pairs can be used with modest performance IRFP9240/IRFP240; 2SJ201/2SK1530; 2SJ118/2SK413; 2SJ119/2SK414.
Q9 and Q11 - Instead BS250 you may use

Exicon ECW20N20 and ECW20P20 lateral MOSFET's can NOT be used on this PCB. PCB need to be redesigned to accommodate lateral mosfet pinout.

Construction Q17

Keep input shorted before any dc or static amplifier measurements. Static mean you only measure voltages in various places.
Start by installing operational and regulator with Q1-Q2-Q3-Q4. Next add Q13 and Q14 capacitor multipliers. Power up at and measure voltages before and after regulators. Before regulators you should measure +45Vdc/-46Vdc. After regulators you may expect around +13.5Vdc and -14Vdc
The two red LED, D1 and D4 must light on.
Mount the rest of parts, short input, power up and measure DC output. This must be under ~40mV.
Voltage across R3 and R13 must be between 500mV and 700mV.
Voltage across R11 and R12 ~3V, a bit higher on R12.
If above measurements are OK, then you may connect Q17 amplifier to a preamplifier, potentiometer or volume controller. Connect output speakers trough a speaker protection module or a 3A fast fuse.
Take care and do not short the amplifier output. There is no protection, unless you have installed a separate one.
In some cases, a soft-start module is needed.

Building active power supply

For proper performance Q17 need a min.300VA transformer. There are E+I, C-core, R-core, Toroidal transformers. Any of them will work, but people ask which is the best. The best is the one that is the best constructed, using proper materials and well executed. However, from theoretical point of view, R-core exhibit lowest EM loss. A well executed R-core can be the best.
Transformer must have dual separate secondary, 2 x 36Vac at min 5A.
Do not measure Saligny rectifiers without filter capacitors. Install all parts and measure when all is in place. Compared to any diode rectifier, Saligny rectifiers do not have voltage loss and you should get 36Vac x √2 = 50.9Vdc at active
Power supply output on each rail.

Measurements

Amplifier do not need specific adjustments and should work from the beginning.
Please allow at least 48h for burn-in. Electrolytic capacitors are the most sensible at burn-in and some need 200h or more.
Mosfet transistors also need burn-in. My personal observation is that after 48h these are ok to go.

In order to perform burn-in, leave your amplifier powered ON. A musical program at low level will help as well.

What you should expect from this amplifier ?
Exceptional dynamics with superb harmonic extension. Strong and round bass. Exceptional midrange with crystal clear top response. Instrument separation localisation in deep 3D.
Enjoy & Thank you !

References:

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