标题: Class D amp discussion [打印本页]

作者: millwood **时间:** 2007-10-24 21:40 **标题:** Class D amp discussion

I would like to start a thread on Class D, knowing that we have a resident expert (fumac) on it.

Class D amps (or PWM amps) have its output stage work like a switch. It was invented in the 1950s and never took off due to poor sound quality and lack of highspeed switching devices.

a few things happened in the last few years.

1. power electronics got a lot better, and mosfets can switch in mhz range.
2. the use of DSP allows noise shaping (pre-distortion) to improve sound quality.

The first successful Class A amp is the Panasonic SA-XR20 which uses the TI TAS PurePath chips. It was called Poorman's Krell when it was introduced. That series goes all the way to XR-70 (XR20, 25, 40, 50, 55, 57 and 70). you could get them for less than $200 in the US, which includes AV functions, 125wx6 or x7 power. pretty good for the money.

then you have T-amp, using Tripath's class D chips.

after that, you have a rebirth of the Class D era.

作者: cglvisa **时间:** 2007-10-24 21:43

看了半天，只认识了一个 YOU 真是晕啊!!!

作者: millwood **时间:** 2007-10-24 21:48

There are basically three types of Class D amplifiers.

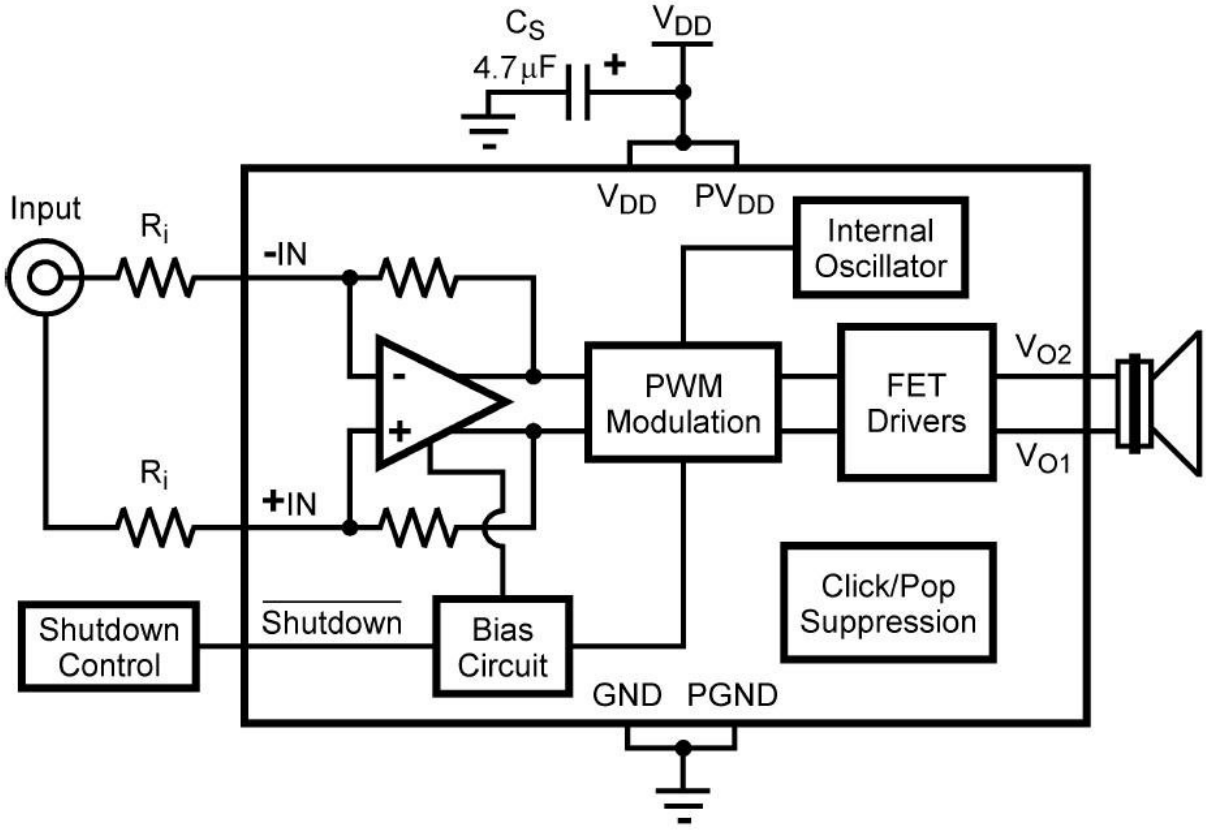
a) open loop analog: this topology takes an analog input, run it through a PWM modulator to get a PWM signal, and have a driver stage that runs either in half bridge or full bridge.

it usually runs on fixed frequency and uses onboard oscillator / clock.

作者: millwood **时间:** 2007-10-24 21:49

this is a typical open loop analog class D amplifier (LM4673):

图片附件: **Open Loop PWM.JPG** (2007-10-24 21:49, 71.33 KB) / 下载次数 209
http://bbs.hifidiy.net/attachment.php?aid=266318&k=c80bc2aa9c96978d0c3a9f5fce2d617a&t=1266022130&sid=88tt3Q



作者: syhkiss **时间:** 2007-10-24 21:50

好象是一个D类放大器的问题

作者: opqgopqg **时间:** 2007-10-24 21:55 **标题:** ...

lz是外国人`?

作者: syhkiss **时间:** 2007-10-24 21:57

millwood ~~~Did you make D enlarger?

问他做过 D 类放大器没有

作者: syhkiss **时间:** 2007-10-24 22:02

$200 在美国,可以做个比较好的 7声道 125w的 AV 功放

好象挺便宜

作者: millwood **时间:** 2007-10-24 22:03

the second type of Class D is open loop digital class D amplifiers.

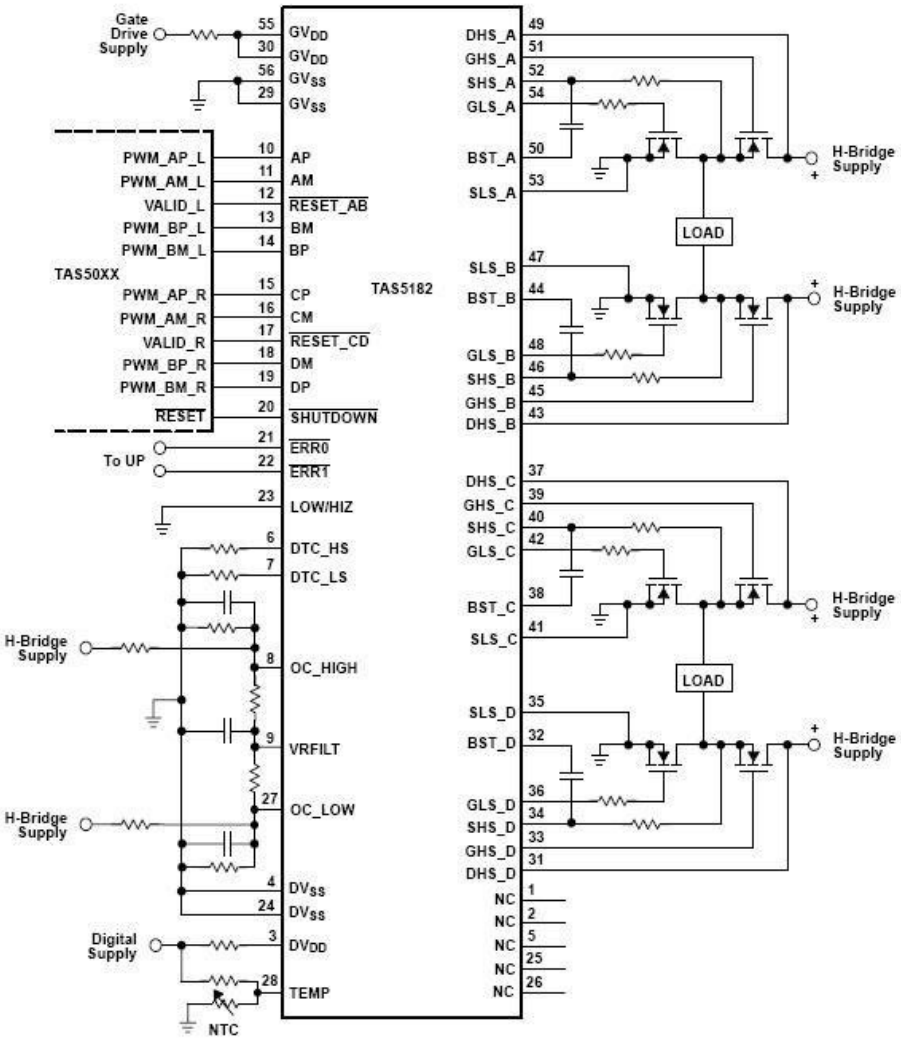
Rather than taking an analog input, they take a digital input (PDM, or PCM or S/PDIF, depending on what the situation may be), and use it to directly drive a PWM modulator.

earlier ones do not pre-distort the input signal, and don't sound quite good due to distortion introduced in the PWM modulation. TI, through an acquisition, found that you can pre-distort the signal in a way so that after it has been distorted by the PWM modulator, it forms great sounding signal after the low-pass filter.

That becomes the TI PurePath family of DSP-based PWM modulators. they typically consists of a PWM controller / processor (TAS5518) driving a few power stages (TAS5182).

图片附件: **Open Loop Digital.JPG** (2007-10-24 22:03, 95.23 KB) / 下载次数 182
http://bbs.hifidiy.net/attachment.php?aid=266336&k=41f2c40e1896ad22ef5737d78f0f88d2&t=1266022130&sid=88tt3Q

SIMPLIFIED APPLICATION CONNECTION DIAGRAM (BRIDGE-TIED-LOAD CONFIGURATION)



NOTE: Recommended power MOSFETs
International Rectifier IRFIZ24N (8 places)
For complete reference schematics contact Texas Instruments.

作者: millwood **时间:** 2007-10-24 22:12

all of the two class d amps are open loop: the output signal is never fedback to the input.

so they suffer from poor PSRR, among other things. TI actually had an application note that uses supply voltage for volume control for its PurePath chips.

the 3rd type of Class D uses feedback. they are called self oscillating class D. They use positive feedback to great oscillation. the feedback signal can be picked up from before the filters (pre-filter feedback) or after the filters (post-filter feedback).

The first that came to the market is IRF's IRAudAmp 1 (https://ec.irf.com/v6/en/US/adir ... QueryName=iraudamp1).

the front-end is a LT1220 that takes the input signal, mixed it with pre-filter feedback. the output is a IR2011S half bridge driver driving two N-channel mosfets.

I have built this one and it sounds quite good.

图片附件: **IRAudamp1 block.JPG** (2007-10-24 22:12, 63.87 KB) / 下载次数 179
http://bbs.hifidiy.net/attachment.php?aid=266337&k=60d43377d8a7c3326310f0d48f5565d1&t=1266022130&sid=88tt3Q

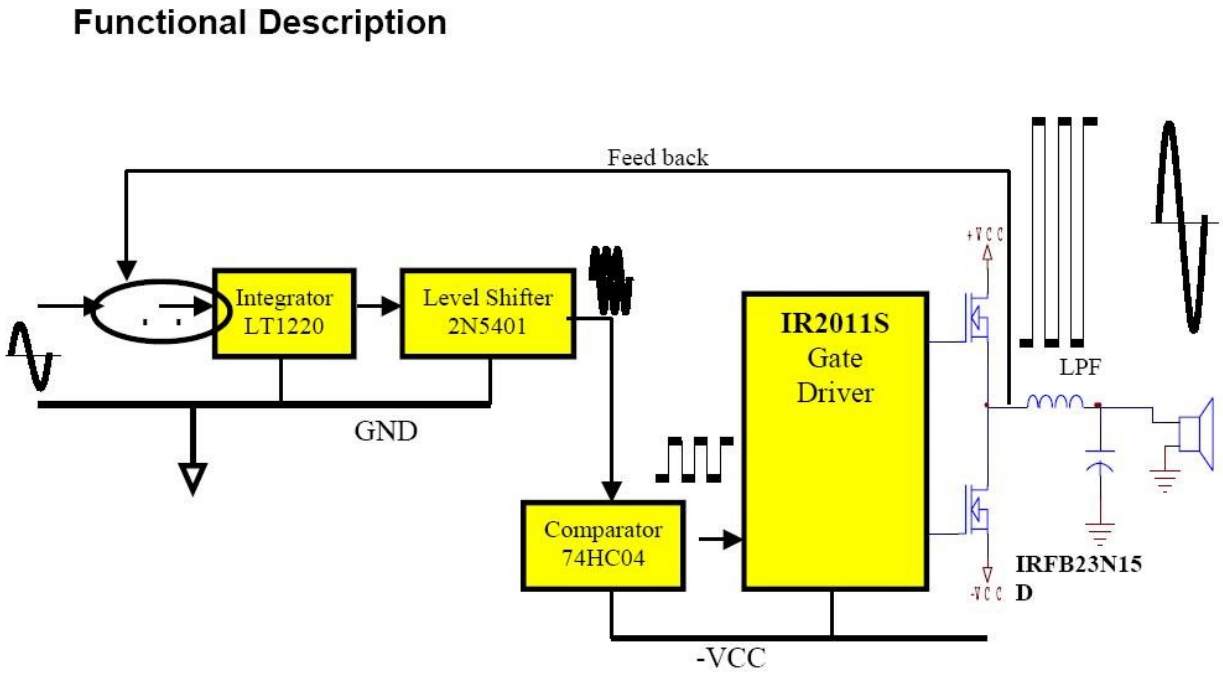


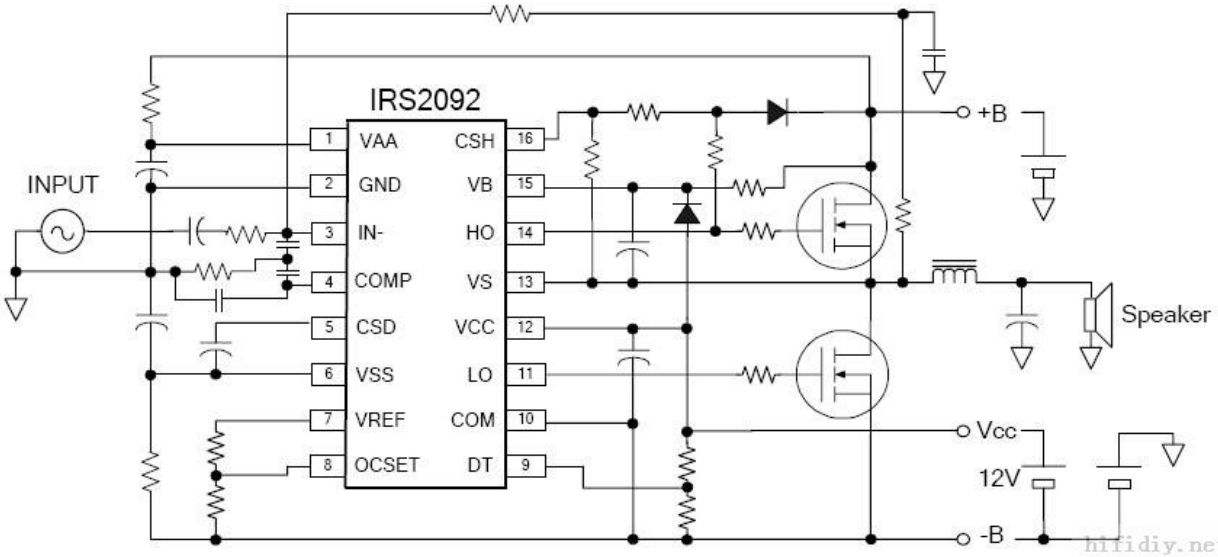
Fig. 3 Simplified Block Diagram of Amplifier

作者: millwood **时间:** 2007-10-24 22:16

IRF made a few versions of its self-oscillating class D amp. the latest is IRAudAmp5, using IRS2092 single chip that integrates the front end (now a transconductance amplifier for speed, comparators and half bridge driver).

Here is its block diagram. Unfortunately, it is not avalable yet. the price is $1 - 2 per chip.
You can build a whole amp for probably less than $10.

图片附件: **IRS2092 Block.JPG** (2007-10-24 22:16, 50.32 KB) / 下载次数 227
http://bbs.hifidiy.net/attachment.php?aid=266345&k=1647f95da7233eb4c261200d005f547d&t=1266022130&sid=88tt3Q



作者: syhkiss **时间:** 2007-10-24 22:19

通过楼主的改造声音非常的棒~

作者: syhkiss **时间:** 2007-10-24 22:23

Use English expression, we understand

But thank very much

作者: Julien **时间:** 2007-10-24 22:29

谢谢millwood的资料，希望多一些这类的讨论。

作者: millwood **时间:** 2007-10-24 22:30

at the same time that IRF was developing its class D amp, Phillips was also working on its class D amp. However, the Phillips design uses post filter feedback for better sound quality and better PSRR.

Here is the original article in AES article (http://www.ciaudio.com/ucd_aes.pdf).

Bruno soon left Phillps and Hyperx started to market a similar design called Universal Class D (UcD) at their website. the first product is UcD180 and now they have UcD700. I have a UcD180 and it sounds very good.

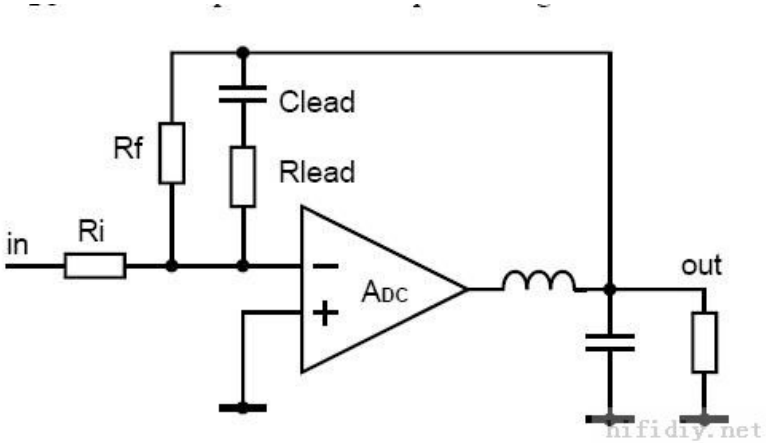
Here is the block diagram for UcD. As you can see, it takes post-filter signal, and feeds it into a conventional amplifier to start a positive feedback loop.

Later in the article, Bruno put forth a schematic that doesn't have device selection nor values.

However, in case you want to do it, Phillips put forther a full application note on almost the same thing (http://www.semiconductors.philips.c...s/UM10155_1.pdf).

I also built it and found it difficult to get started. I have also tried to build one with a half bridge driver but that had problem oscillating during the negative half of the signal. But this is in fact the Hypex module so it should work. Other people have reported success with the Philipse application note.

图片附件: **UcD Block.JPG** (2007-10-24 22:30, 14.08 KB) / 下载次数 170
http://bbs.hifidiy.net/attachment.php?aid=266362&k=38896beb2fdf5988ea5063d8fa02cfe5&t=1266022130&sid=88tt3Q



作者: 农民工！ **时间:** 2007-10-24 22:34

看不懂！

作者: millwood **时间:** 2007-10-24 22:40

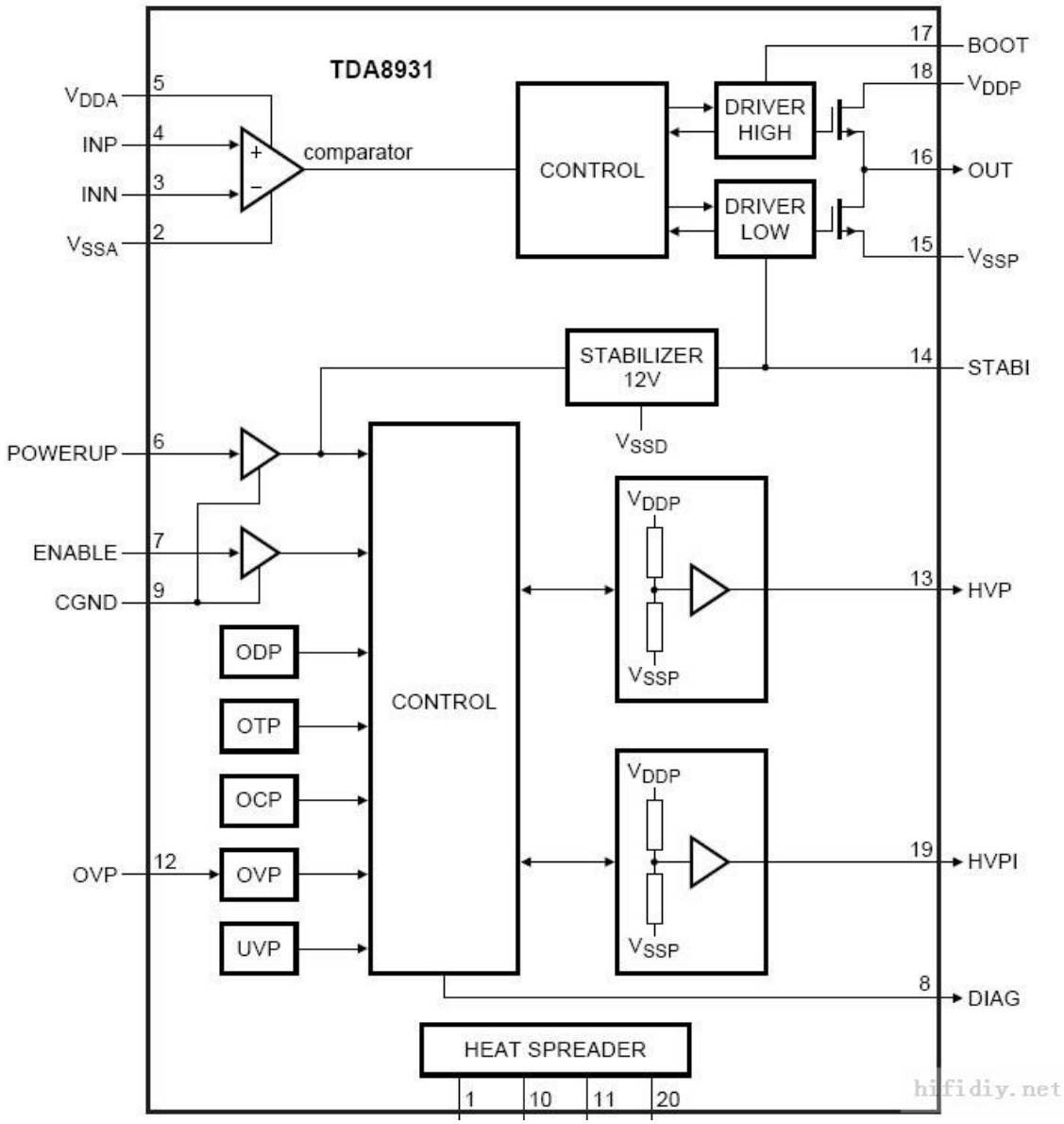
the IRF amps are nothing but sigma delta modulators. a lot of small power class D chips are of such a design. the AD1990 family for example is a typical sigma delta modulator and you can take the output and drive a set of half bridge for high power applications.

the most promising, however, is the Phillips TDA8931 (http://www.nxp.com/acrobat_download/datasheets/TDA8931_1.pdf). If you look at the blockdiagm, it is identical to IRS2092: a front end preamp that functions like a comparator, driving a half bridge with integrated mosfet power devices.

so you can use it to form either a UcD type amplifier or IRAudamp class D amp.

and it costs less than $2.5 each from digikey.

图片附件: **TDA8931 block.JPG** (2007-10-24 22:40, 64.81 KB) / 下载次数 168
http://bbs.hifidiy.net/attachment.php?aid=266385&k=44e90622f02980e4cba44b12bd641243&t=1266022130&sid=88tt3Q



作者: ideal-v **时间:** 2007-10-24 22:42

恩,希望来点比较深入点的理论知识.以上不够

作者: ideal-v **时间:** 2007-10-24 22:45 **标题:** 回复 #10 millwood 的帖子

这个是IR方案的,小功率还可以.但对布局的要求高

作者: 日王贝才 **时间:** 2007-10-24 22:55

26个英文字母偶都认识

作者: hwajun99 **时间:** 2007-10-24 23:14

D类放大器的常识普及资料吧，好象和技术无关，只不过附了3种典型的D类功率IC的应用。

作者: FUMAC **时间:** 2007-10-25 01:27

普及技术,我认为正是这里缺的,
我们应该感谢millwood

thank u millwood
i think ,u do the right thing, good for anyone here
but , i have no time to do this job.
perhaps my post just for let somebody know me
another saying is saling myself

i have read most of class-d technolegy, but all of them r not for diy,

because the smd and the pcb design and test equments, qiuite diffrent with class-abc
most of diyer r not good at this
so...

i have design ucd and iramp and chips class-d,
i think,
if anybody like to make a class-d amp, all of them is ok
i have told others, high speed pcb design is 80% of a good class-d amp
this link
http://bbs.hifidiy.net/viewthrea ... p;extra=&page=1

we had design 6 version, in fact we have design 12 to 20 version (2~3versions per time)
now we r going to a new version. diffrent tech, but not for diy again.

i think u can keep this topic going on, i will be a good reader

best rg

fumac

作者: locky_z **时间:** 2007-10-25 09:06

我认为第一种和第3种中IR的差不多，
第1种是固定震荡频率的PWM调制器，
第3种中的IR方案其实也是"固定"震荡频率，没有信号时就是一个方波振荡器，输出是方波，输入端有电容积分，将反馈回来的方波变成三角波，然后再和输入信号比较，形成固定频率的PWM调制。可以对比一下运方的PWM调制电路就知道两者其实是一样的，是固定频率的PWM调制器。

第2种需要数字处理技术，太深奥了。
第3种UCD方案理论上也很复杂，可能是非固定震荡频率的。

我认为固定PWM调制方式由于死区时间限制，其动态范围不大。例如100K固定频率，其周期10us，如果死区时间10ns，那么方波最窄10ns,最宽9999ns，那么动态范围只有9999/10=999倍，只有60db。

作者: 学习中 **时间:** 2007-10-25 09:38

水平不够,看不明白.

作者: 激光鼠 **时间:** 2007-10-25 09:43

> 原帖由 *syhkiss* 于 2007-10-24 22:19 发表
> 通过楼主的改造声音非常的棒~

楼主改造了什么？

作者: younglee **时间:** 2007-10-25 10:44

Class D!Very good!

作者: anbbb **时间:** 2007-10-25 11:15 **标题:** 这东西效率高的很，但是不怎么HIFI

这东西效率高的很，但是不怎么HIFI

作者: 给我十个胆 **时间:** 2007-10-25 11:20

欢迎外国朋友一起来探讨

作者: FUMAC **时间:** 2007-10-25 12:03

> 原帖由 *ideal-v* 于 2007-10-24 22:45 发表
> 这个是IR方案的,小功率还可以.但对布局的要求高

不管什么方案，布局对性能占了80%以上的比重。
小功率不明显，功率越大越明显

另外，D类的分类并不是只有一种方式，D类在这几年的发展产生很多分支。
从拓扑结构而言，有单端，半桥，全桥（我正在实验单端的）
从工作方式而言有PCM，PWM，再细分是自震荡和外部震荡
从反馈角度而言有，无反馈，滤波前反馈（IR），滤波后反馈（UCD），滤波前后双路反馈（小弟的MCD），还有数字反馈（D2AUDIO）
另外从供电方式而言就更复杂，有王冠的BD方式，还有滑动供电方式，电源和放大的混合电路方式（不是简单的组合）

另外，说个有点点争议的问题，
国内没几个朋友知道，D类之父是布来恩 阿悟德（Bryen artwood ），此老头为天人，
现在还没有一个D类的拓扑能逃脱他的专利（以上提到的各种方式他都有研究过），因为他发明的早，大部分都过期了
75了，还在工作。

作者: younglee **时间:** 2007-10-25 13:25

Class D 在Hi-Fi DIY的发展上应该直得探讨一下！

作者: 苗个球 **时间:** 2007-10-25 14:40

看不懂

" 书到用时方恨少，船到江心知浪急 " .....

作者: FUMAC **时间:** 2007-10-25 15:17

> 原帖由 *locky_z* 于 2007-10-25 09:06 发表
> 我认为固定PWM调制方式由于死区时间限制，其动态范围不大。例如100K固定频率，其周期10us，如果死区时间10ns，那么方波最窄10ns,最宽9999ns，那么动态范围只有9999/10=999倍，只有60db。

我记得你应该在我的那个帖子上也提出过类似的问题,
我曾经回答过
你还是没弄懂其中的关系
找了半天,找到了以前的答复

QUOTE:
原帖由 locky_z 于 2007-5-25 08:36 发表
PWM的动态范围是不是最大脉冲宽度/最小脉冲宽度？
如果在1M调制频率下，只有1us的宽度，如果输出驱动IC的死区时间为10ns，对应最大宽度为990nS，最小宽度10ns,动态范围只有990倍？(
PWM的动态范围是不是最大脉冲宽度/最小脉冲宽度？

不是，毫无关系
你说的是分辨率，所以你得出了错误的结论

先看看什么是动态范围
在网上搜索到的两个解析：
动态范围：
动态范围最早是信号系统的概念，一个信号系统的动态范围被定义成最大不失真电平和噪声电平的差。
而在实际用途中，多用对数和比值来表示一个信号系统的动态范围，
比如在音频工程中，一个放大器的动态范围可以表示为：
D = log (Power_max / Power_min) ×10 ;

Dynamic range(动态范围)
是最大信号振幅与微弱信号噪声水平(RMS值)的比率。对器材来说，动态范围表示这件器材对强弱信号的兼顾处理能力。

动态范围只和两个因素有关，最大不失真功率，和低噪

假设低噪一样，功率越大动态范围越大
但是实际上功率越大，低噪水平越高。

你说的最小占空比和最大占空比比值是衡量数字转PWM系统的分辨率的，
但是我这个D类功放是模拟形式的PWM也就是说他的PWM占空比不是及进的，而是连续的，
就好像南海222的说法类似
所以不存在分辨率不够的问题。
你把有些概念混淆了：)
如果不明白，继续问

原帖在这里
http://bbs.hifidiy.net/viewthrea ... page%3D1&page=9

你提出的原因,并不能说明最后的结果.
死区时间主要影响失真和发热.并不会影响动态范围.

作者: locky_z **时间:** 2007-10-25 17:21

我不说UCD或者MCD，他们可能是非固定频率，可能占孔比不影响。

现在只说第一种固定频率的PWM调制，也就是压控占空比发生器，并且假设是线性的，
1. 假设输入信号为0-2V,0V时占孔比最小，脉宽为0ns的话，2V时占空比最大，脉宽为10000ns,那么折合对应为0.2mV/ns宽度，如果输入信号为0.2mV的话，应该脉宽1ns，但由于死区时间为10ns,就是说输入信号为0.2mV-2mV,他们的脉宽都被固定在10ns吧？就是说很小很小的信号不能被区别出来吧？

2.你说连续的指的是：例如输入信号大于2mV,例如2.01mV和2.02mV,此时他们的脉宽分别为10.05ns和10.1ns，此时因为大于10ns，因此能分辨出2.01mV和2.02mV之间的0.05mV的区别吧？

究竟最小分辨电压说的是1还是2这种情况？

如果USC,MCD的调制频率不是固定的，例如在大信号时调制频率较低，例如降低到10K，此时脉宽可以扩宽到1000000ns。

作者: xlf0602 **时间:** 2007-10-25 18:38 **标题:** 回复 #23 locky_z 的帖子

我觉得你23楼的说法问题出在你把方波最宽时当成输出功率最大，方波最窄时当成输出功率最小。实际上应该是方波最宽时对应于输出信号的“波峰”（或波谷），方波最窄时对应于输出信号的“波谷”（或波峰），这二种情况下都是最大峰值功率输出时。而二只输出管输出的方波的占空比相等时对应于输出信号的“零”，这时才是输出功率最小的时候。输出信号的大小是取决于二只输出管输出的方波占空比的相对关系。

作者: FUMAC **时间:** 2007-10-25 20:54

> 原帖由 *locky_z* 于 2007-10-25 17:21 发表
> 我不说UCD或者MCD，他们可能是非固定频率，可能占孔比不影响。
> ---
> UCD, MCD频率都是相对固定的,其原理均为RC 或者LC震荡, 并非压控振荡器,
> UCD为350k~450k,单个板子固定频率,不同的板子有差异,
> MCD是800k~1.2(实际产品频率,实验室频率达到3.5mhz,还没到实用阶段).单个板子固定频率,不同的板子有差异,
> 这个差异是RC 或者LC的误差决定的.
> 动态频率的最显著的例子是class-t, 频率范围是300k~1.5m(大概,他没详细的说明,他只说平均为600k),根据电平的不同,频率变化很大.
>
> 如果UCD,MCD的调制频率不是固定的，例如在大信号时调制频率较低，例如降低到10K，此时脉宽可以扩宽到1000000ns。
> ---
> 上面已经说明,无论大小功率,频率都是恒定的

xlf0602---正解

> 原帖由 *xlf0602* 于 2007-10-25 18:38 发表
> 我觉得你23楼的说法问题出在你把方波最宽时当成输出功率最大，方波最窄时当成输出功率最小。实际上应该是方波最宽时对应于输出信号的“波峰”（或波谷），方波最窄时对应于输出信号的“波谷”（或波峰），这二种 ...

作者: 音响DSP **时间:** 2007-10-25 21:19

看来TDA8931可以做UCD的理论实践,嘿嘿~~~

作者: millwood **时间:** 2007-10-25 21:47

> 原帖由 *音响DSP* 于 2007-10-25 21:19 发表
> 看来TDA8931可以做UCD的理论实践,嘿嘿~~~

that was precisely my point.

tda8931 has differential input and that makes it a good candidate to try either UCD or IRAudamp.

However, it is a single rail / half bridge implementation and the datasheet is not clear on how the input signal is referenced.

IRS2092 has similar structure, except that the + input is tied to the ground in the datasheet.The blockdiagrahm has it connected to the + input. However, no one has that chip yet to know if it can be reconfigured.

another chip with both indifferential inputs is the TI buck converter, TPS40056. Here is its block diagrahm:

the output voltage tracks the voltage applied to pin 4. so if you apply an audio signal there, it should work.

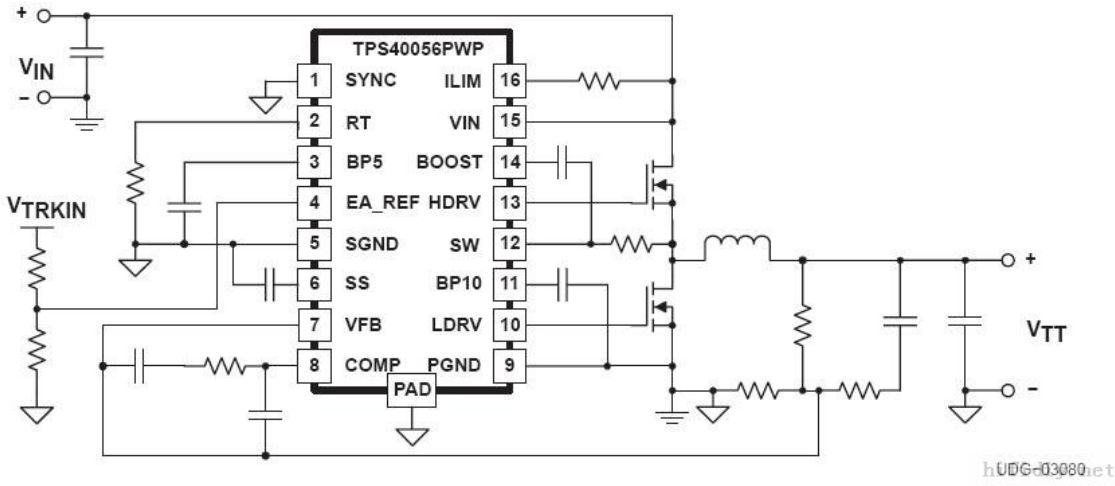
The chip runs up to 1mhz, and TI says it is designed for good "transient response" - a great thing for audio.

Unfortunately, it goes up to just 40v but should be good for a low power class D amp.

It is not, however, a self-oscillating amp as it uses an onboard oscillator.


图片附件: **tps40056 block.JPG** (2007-10-25 21:47, 48.12 KB) / 下载次数 67
http://bbs.hifidiy.net/attachment.php?aid=266952&k=458eb23c46baf2b8fa11411fc64281a1&t=1266022130&sid=88tt3Q

SIMPLIFIED APPLICATION DIAGRAM



作者: millwood **时间:** 2007-10-25 21:51

> 原帖由 *FUMAC* 于 2007-10-25 12:03 发表
>
> 不管什么方案，布局对性能占了80%以上的比重。

that is absolutely true. Class D amps work in excess of 300Khz and we are almost talking about RF amps here.

I have always breadboarded my (analog) audio amps but have found breadboarding Class D amps to be quite difficult.

作者: FUMAC **时间:** 2007-10-25 22:07

TPS40056这个电路结构应该加个输出电容吧,除非改成+/-供电

作者: millwood **时间:** 2007-10-25 22:15

> 原帖由 *FUMAC* 于 2007-10-25 22:07 发表
> TPS40056这个电路结构应该加个输出电容吧,除非改成+/-供电

yes, you will need to block the DC.

the tda8931 datasheet has a nice way of doing it.

作者: lm1875a **时间:** 2007-10-25 22:57

Hi Millwood,
welcome to this bbs!!! Can you tel me, are you Chinaese?

Sorry! I just know a little English

作者: FUMAC **时间:** 2007-10-25 23:01

he is chinese, but he cant type chinese

靠,搞错了
他是中国人,但是他的电脑无法打中国字

作者: lm1875a **时间:** 2007-10-25 23:14

> 原帖由 *FUMAC* 于 2007-10-25 23:01 发表
> he is chinese, but he cant type chinese
>
> 靠,搞错了
> 他是中国人,但是他的电脑无法打中国字

收到！

作者: xdgw **时间:** 2007-10-25 23:28

我发个输出入法给你试试能不能输入中文，yes OR no

作者: xdgw **时间:** 2007-10-25 23:35

智能五笔应能在英文系统下出中文的

作者: xdgw **时间:** 2007-10-25 23:40

http://www.sofriend.cn/bbs/viewthread.php?tid=246

作者: FUMAC **时间:** 2007-10-26 00:45

有些时候,在国外的中国人的电脑并不方便安装中文输入法,
不要难为他了

作者: millwood **时间:** 2007-10-26 01:42

> 原帖由 *xdgw* 于 2007-10-25 23:28 发表
> 我发个输出入法给你试试能不能输入中文，yes OR no

sure.

作者: 杰哥哥 **时间:** 2007-10-26 02:55

金山快译 勉强能行吧？哈哈。。

作者: millwood **时间:** 2007-10-26 08:35

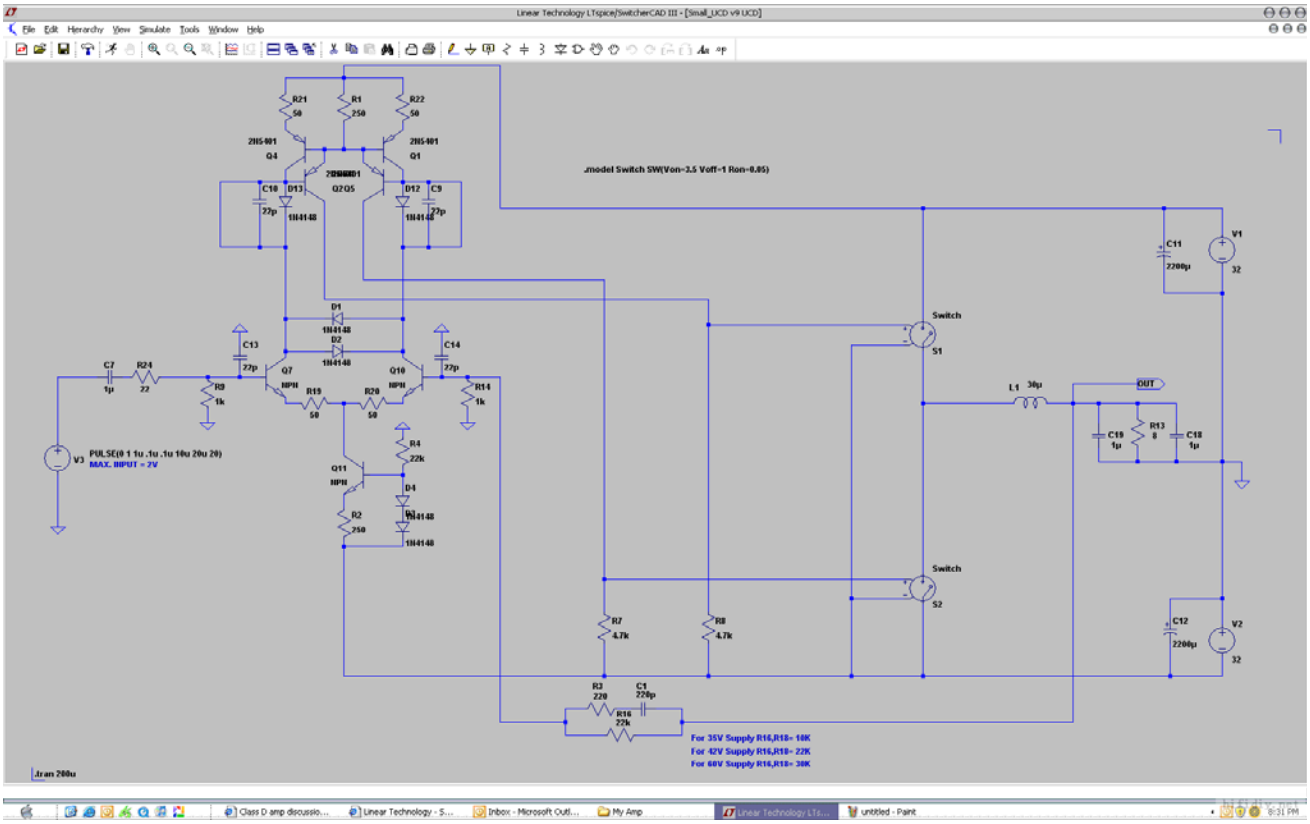
here is a simplified UcD class D amplifier.

the front end is a typical comparator. the driver stage is theoretical so you cannot build it yet. You can, however, use a half bridge driver and two switchers to build the 2nd stage to make it functional.

the switchcad file is updated in .rar format. you can play with it and see how it works.

enjoy.

图片附件: **my small ucd v9 ucd.GIF** (2007-10-26 08:35, 31.97 KB) / 下载次数 132
http://bbs.hifidiy.net/attachment.php?aid=267149&k=a962efd98568ac765316e883885f877e&t=1266022130&sid=88tt3Q



附件: **Small_UCD v9 UCD.rar** (2007-10-26 08:35, 2.03 KB) / 下载次数 218
http://bbs.hifidiy.net/attachment.php?aid=267150&k=188785acdb35231197e66697b68802af&t=1266022130&sid=88tt3Q

作者: younglee **时间:** 2007-10-26 08:40

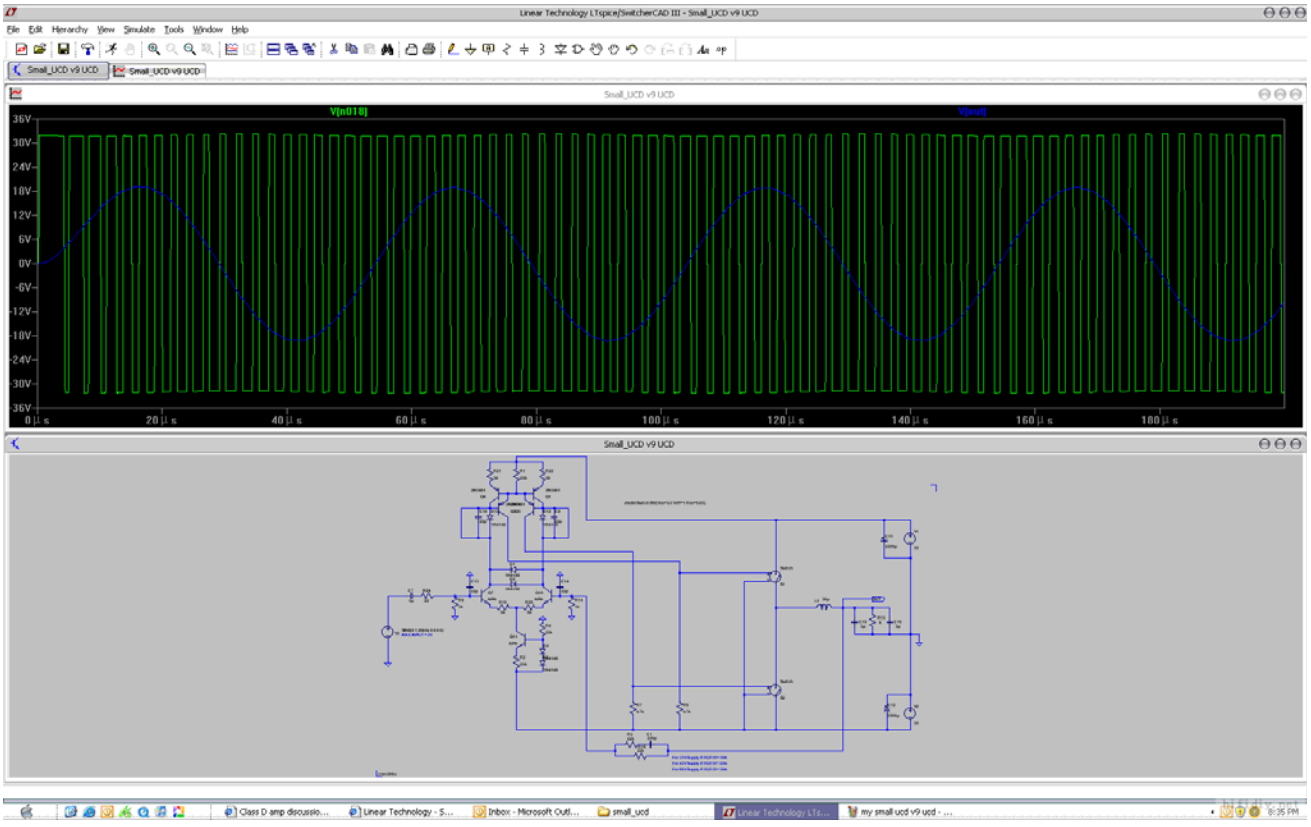
millwood,在哪？Class D好玩吧？

作者: millwood **时间:** 2007-10-26 08:40

here is the simulation results for the previous amp, driven by a 20khz sine signal.

the green line is pre filter pwm output, and the blue line is the post filter audio signal.

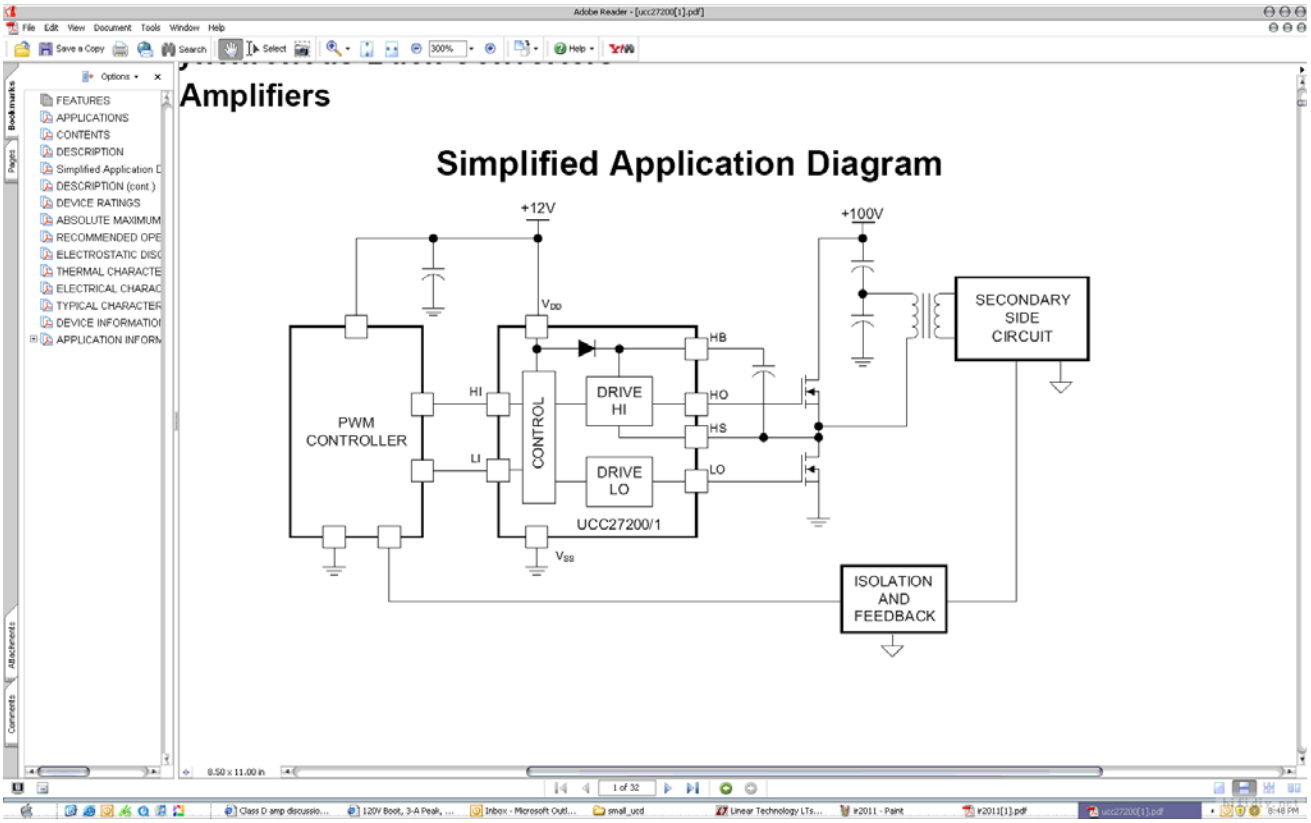
图片附件: **my small ucd v9 ucd output.GIF** (2007-10-26 08:40, 64.75 KB) / 下载次数 92
http://bbs.hifidiy.net/attachment.php?aid=267151&k=9d01b043f68bba7554ccc535be5d1b47&t=1266022130&sid=88tt3Q



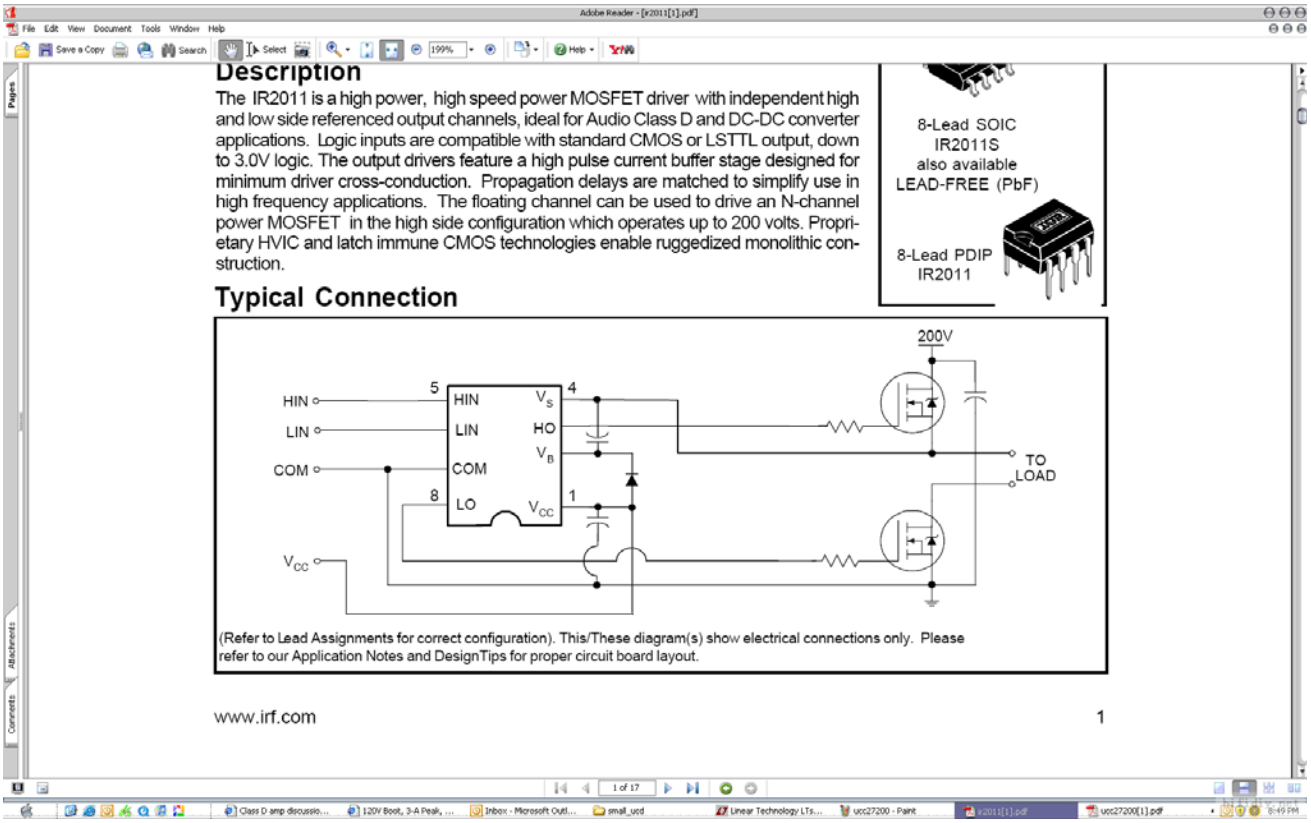
作者: millwood **时间:** 2007-10-26 08:50

you can use a typical half bridge driver, like ir2011 family (from IRF), or lm5100 family (national), or ucc27200/ucc27201 (TI) or any other mosfet drivers - On Semi has a few as well.

图片附件: **ucc27200.GIF** (2007-10-26 08:50, 53.57 KB) / 下载次数 90
http://bbs.hifidiy.net/attachment.php?aid=267155&k=dd93c809ab52dc6e5a56db0a620f9d62&t=1266022130&sid=88tt3Q



图片附件: **ir2011.GIF** (2007-10-26 08:50, 80.17 KB) / 下载次数 76
http://bbs.hifidiy.net/attachment.php?aid=267156&k=c5a0fb086b3ff2bf001c9571be48995b&t=1266022130&sid=88tt3Q



作者: millwood **时间:** 2007-10-26 08:51

I have to say that I have not been able to get UcD with mosfet driver working. Not sure why but it wouldn't work on the high side. Need more experiment, I guess.

作者: 音响DSP **时间:** 2007-10-26 09:39

在某些仿真软件，如EWB8就无法启动UCD的电路，也许有些收敛条件要改下。
至于你提到的TDA8931是自激振荡（NXP叫它为“SODA”）的结构，那双声道的TFA9810T倒可以让我去试下UCD的结构，其实应该是普通D类滤波器前反馈+滤波器后相移修正反馈网络。这样不用拿NXP的UCD分立电路来搞了，直接拿块TFA9810T的DEMO板来试。

作者: 音响DSP **时间:** 2007-10-26 10:00

原帖由 *millwood* 于 2007-10-25 22:15 发表

yes, you will need to block the DC.

the tda8931 datasheet has a nice way of doing it.

TI and IRF
NXP

作者: gogowatch **时间:** 2007-10-26 12:36 **标题:** UCD on breadboard with IRF540N

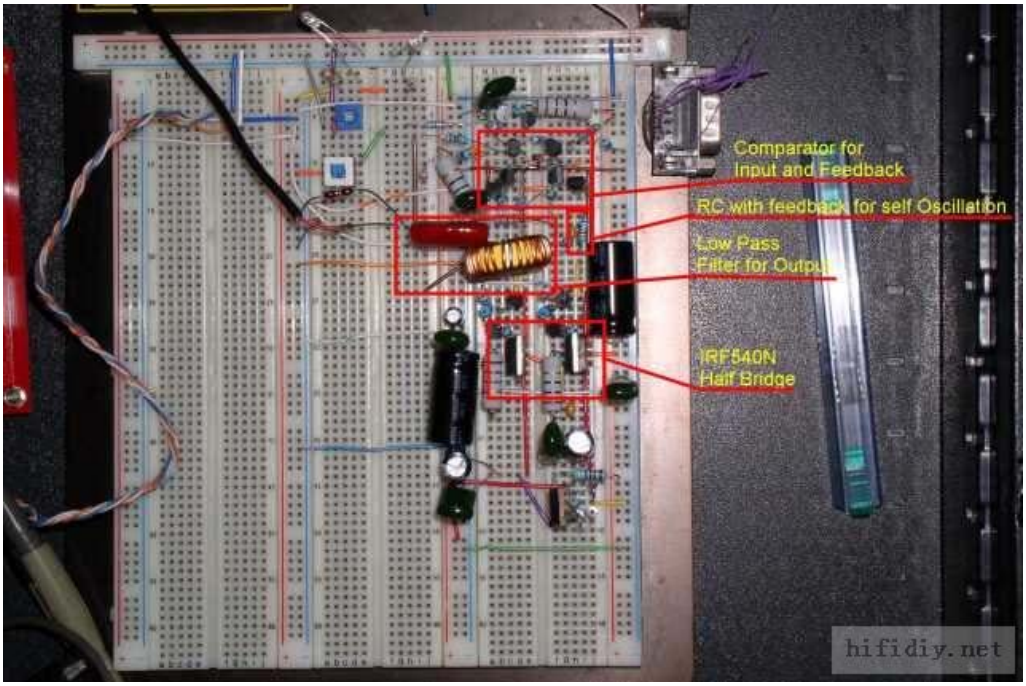
回复 #54 millwood 的帖子

I did make UCD working good on a breadboard with IRF540N a few months ago. Attached are the pictures of the breadboard setup and some oscilloscope traces. I have made some a PCB off from the same circuit giving even cleaner output.

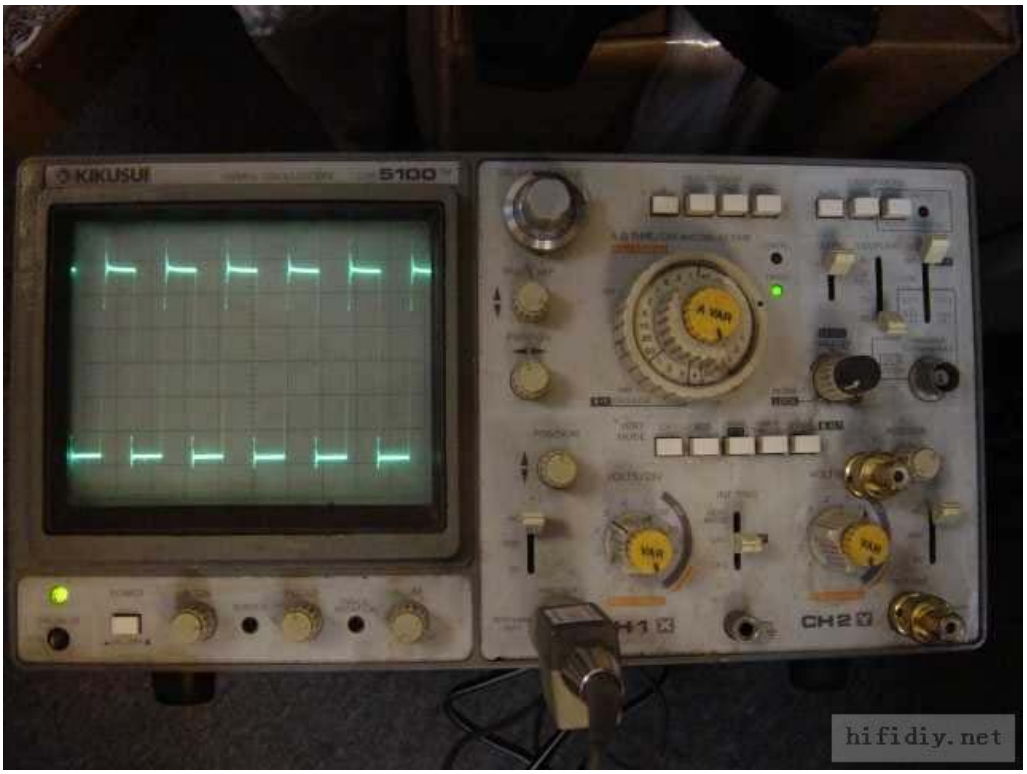
Attached also my LTSpice simulation files. For those who interested in the simulation, you can download the software from http://www.linear.com/designtools/software/#Spice.

Cheers

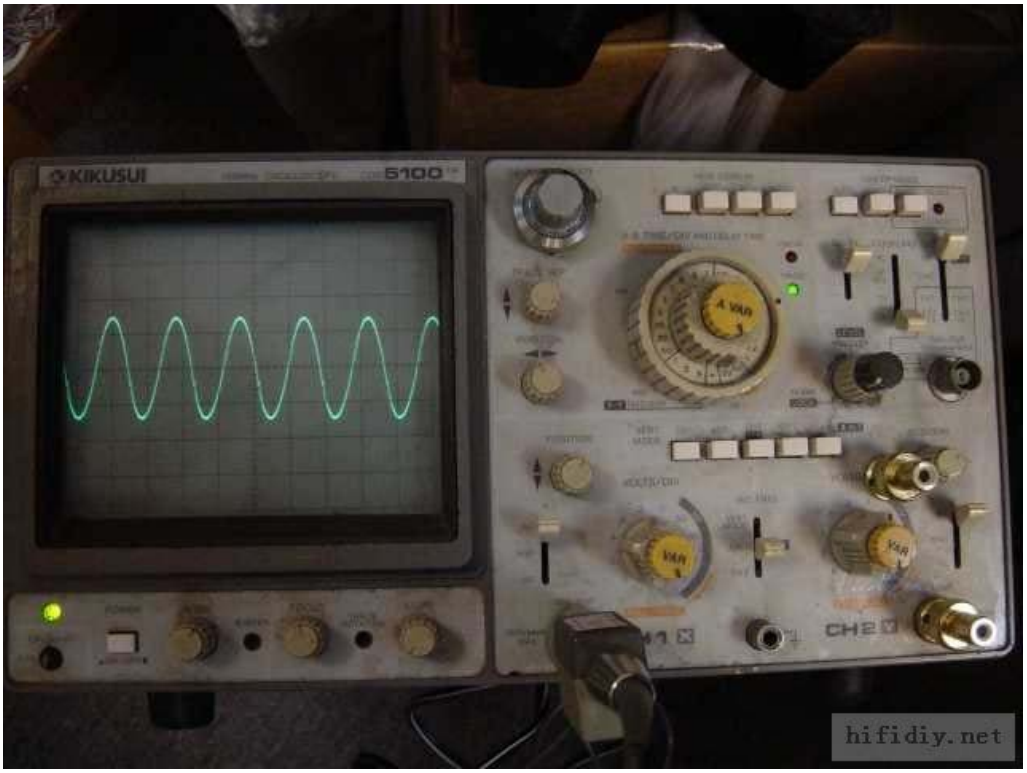
图片附件: [UCD on Breadboard] **Class D Amp on Breadboard-640x480.jpg** (2007-10-26 12:36, 69.9 KB) / 下载次数 84
http://bbs.hifidiy.net/attachment.php?aid=267285&k=9cdcc5e6fd6d334b0d4da7e9f83fe886&t=1266022130&sid=88tt3Q



图片附件: [Output before Filter 1us,5V/div] **MosFet-output-1us,5V-640x480.jpg** (2007-10-26 12:36, 36.47 KB) / 下载次数 76
http://bbs.hifidiy.net/attachment.php?aid=267286&k=881c353b37ce87000e18066ab7b643ee&t=1266022130&sid=88tt3Q



图片附件: [Residue output after Filter 1us,100mV/div] **Output-after-Low-Pass-Filter-1us,100mV-640x480.jpg** (2007-10-26 12:36, 37.68 KB) / 下载次数 62
http://bbs.hifidiy.net/attachment.php?aid=267287&k=aa6cc41541f26bfe2f2d30f1a9853fae&t=1266022130&sid=88tt3Q



附件: [Simulation files] **UCD-Philips-App-Note-UM10155.rar** (2007-10-26 12:36, 4.09 KB) / 下载次数 151
http://bbs.hifidiy.net/attachment.php?aid=267288&k=6ae4bed86148b8d1809704209c3c7f6e&t=1266022130&sid=88tt3Q

作者: millwood **时间:** 2007-10-26 18:41

gogowatch: have you tried to use an integrated driver rather than a discrete driver there? my discrete version of the ucd worked as well but i have never been able to get the version with an integrated driver (I tried three of them) to work.

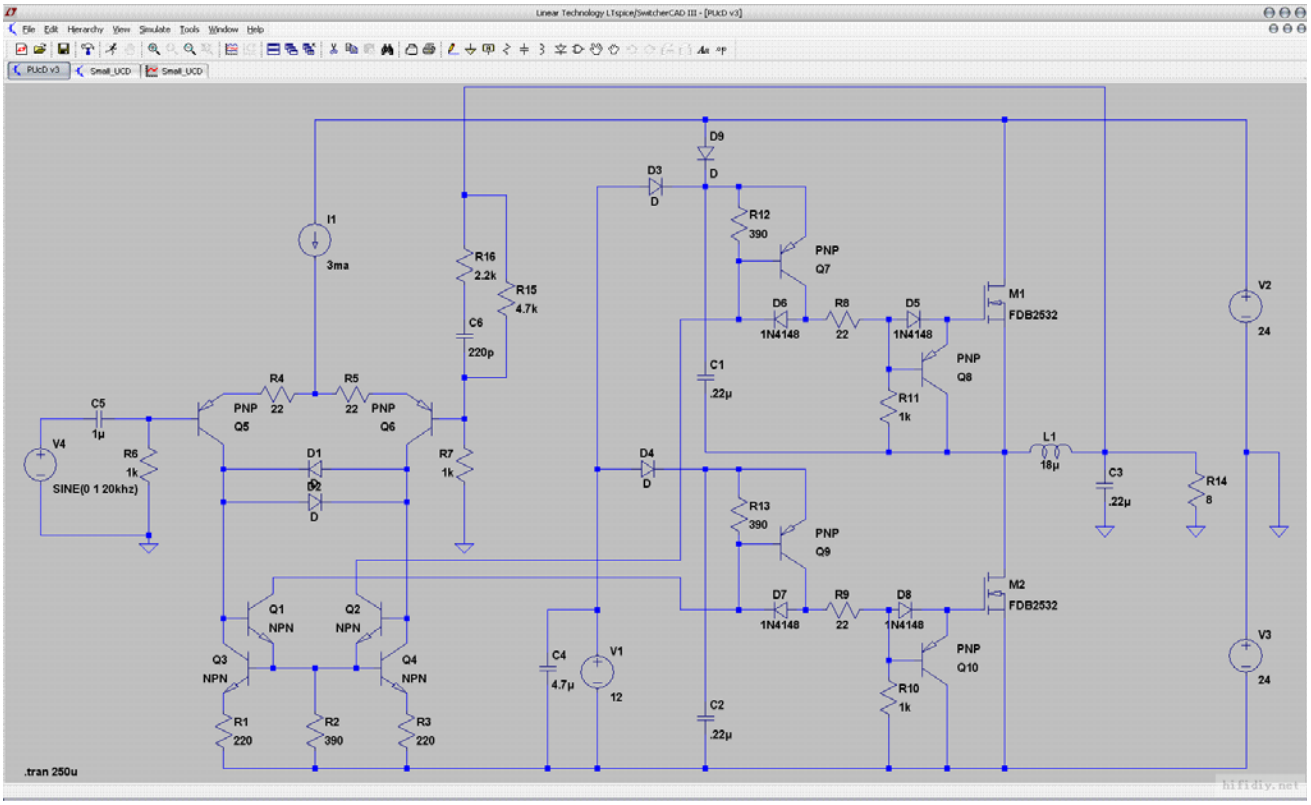
here is my version based on the phillips application note.

作者: millwood **时间:** 2007-10-26 18:43

here is the schematic:

followed by the switchcad simulation file.

图片附件: **pucd v3.GIF** (2007-10-26 18:43, 52.44 KB) / 下载次数 166
http://bbs.hifidiy.net/attachment.php?aid=267492&k=4a80e49e5b29834276ee12d289a202ee&t=1266022130&sid=88tt3Q



附件: **PUcD v3.rar** (2007-10-26 18:43, 1.61 KB) / 下载次数 154
http://bbs.hifidiy.net/attachment.php?aid=267493&k=413e8f1988a35184c19b6a402d8ef20d&t=1266022130&sid=88tt3Q

作者: gogowatch **时间:** 2007-10-26 20:29 **标题:** 回复 #58 millwood 的帖子

Hello millwood,

Thanks for starting this thread.

I'm also trying to make a UCD by using IC gate drivers but still not yet get it done. Those drivers are very easy to blow and I did several times just because of careless mistake.

I took an approach to develop the circuit stage by stage. Following is my sequence,

1. Get a triangular wave from a Signal generator or generate it from a simple opamp circuit.
2. Feed the triangular wave and the ground signal to a comparator. I'm using LT1016.
3. Level shift the comparator output down to the negative rail.
4. Implement a dead time generator for the pair of PWM signals. I used a XOR gate, a cap and a resistor to do the job.
5. Feed the final PWM signals with dead time to the IC gate driver. I tried UCC27201, HIP20101, LM5101.
6. Feed the output of the gate driver to a half bridge mosfet network.
7. Feed the output of the mosfet to the low pass LC filter.
8. Measure the signal delay from comparator to the output of the low pass filter, calculate the value of RC network for self oscillation and finally remove the siggen input and complete the feed back loop

I'm still at step 6 today. I found the fast rise and fall of the IC driver output make transient and ringing of the mosfet output very difficult to control. I plan to make a PCB to do the experiment.

Hope this helps.

BTW, have you checked this thread in diyaudio.com?

http://www.diyaudio.com/forums/showthread.php?postid=778406

Cheers

作者: gogowatch **时间:** 2007-10-26 20:36

The ucd patent document should help too.

Cheers,

附件: [UCD Patent Document] **ucd-patent-2.pdf** (2007-10-26 20:36, 100.19 KB) / 下载次数 461
http://bbs.hifidiy.net/attachment.php?aid=267583&k=4b6a46c70cbff0d89fb89f21168e9862&t=1266022130&sid=88tt3Q

作者: kunkun **时间:** 2007-10-26 23:32 **标题:** 回复 #31 苗个球 的帖子

傻了吧:

作者: millwood **时间:** 2007-10-27 08:02

gogowatch: thanks for your reply.

1) how do you like the ti driver? I just order some and am waiting to receive it and ucc27201. I would appreciate your experience with it, vs. other drivers (ir2011, and the onsemi one (ncp5181?)). I have used lm5101 and it is too fragile.

2) the diy thread. it sounds quite interesting. I would 2nd their view on fdp3682. I have had a few of them and they blew up so easily where my irf540 have lasted long long time.

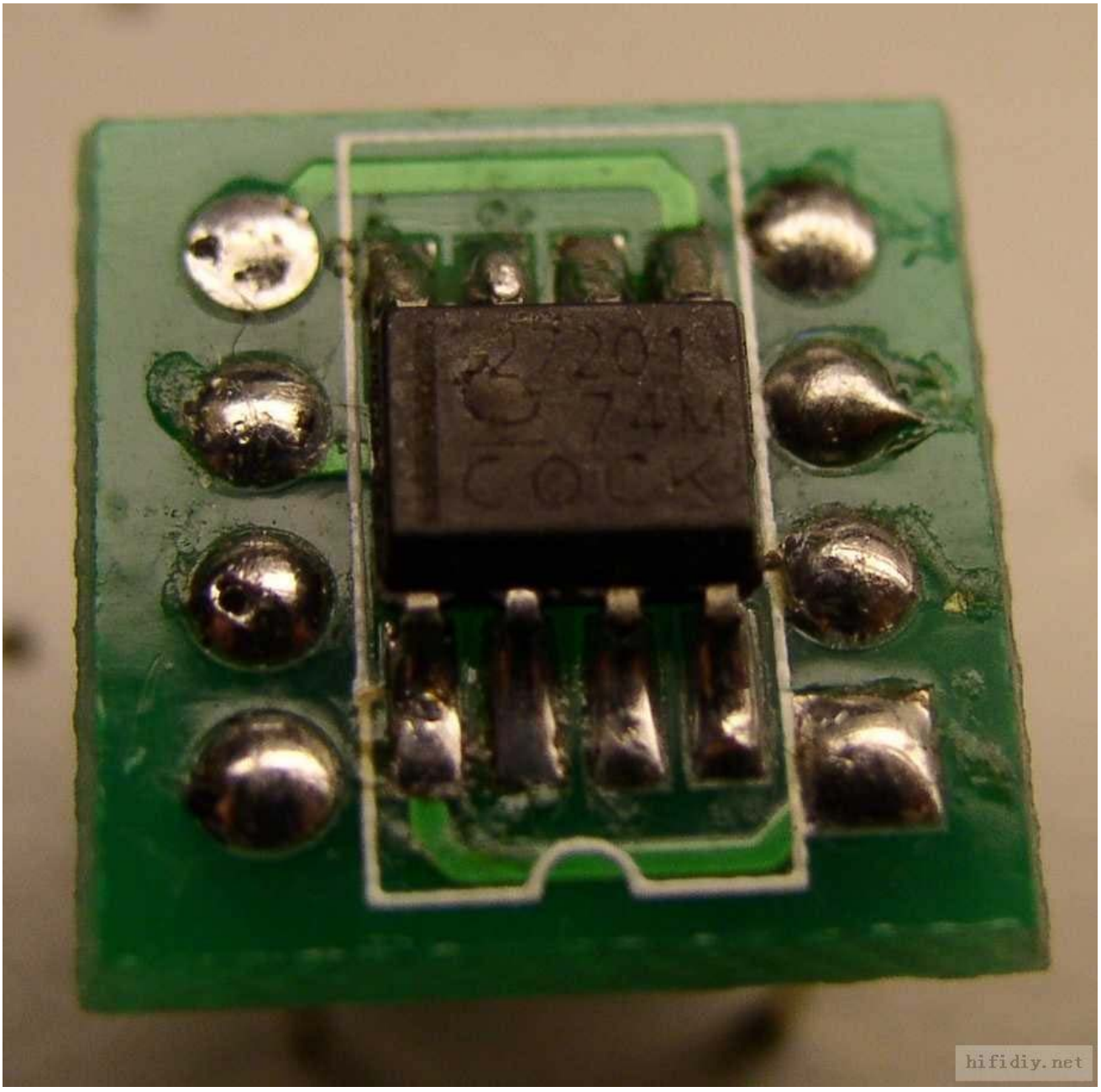
作者: gogowatch **时间:** 2007-10-27 12:19

1. I have experience with LM5101, UCC27201 and HIP2101 only. LM5101 and UCC27201 are powerful driver chips and I blew up all my available one before I can make careful measurement from them. I believe they will work as good as it is specified in the datasheet. My advise is that you have to be extremely careful when probing the live circuit or you will have a result as shown in the attached picture. I saw a bright spark on the chip between pin 7 and 8 and a small mushroom cloud was developed by the time it was blew up. You can imagine how powerful the driver chip is. I use HIP2101 in my experiment now because it is less powerful and I can get it from taobao. I got LM5101 and UCC27201 as samples from manufacturer.

2. How do you generate the dead time and the level shift? I did dead time generation as shown in http://users.tkk.fi/~jwagner/electr/pwm-deadtime-gen and level shift simply by a pair of PNP transistor.

Cheers

图片附件: [broken ucc27201] **ucc27201-blown.jpg** (2007-10-27 12:19, 76.69 KB) / 下载次数 73
http://bbs.hifidiy.net/attachment.php?aid=267920&k=ba845131fa140e5038c7f3ea2757a6b8&t=1266022130&sid=88tt3Q



作者: millwood **时间:** 2007-10-28 05:01

gogowatch: thanks for your reply and tips.

I rely on the driver chips to manage deadtime. I don't use chips that have too much deadtime (common for smps drivers), or no shoot-through detection.

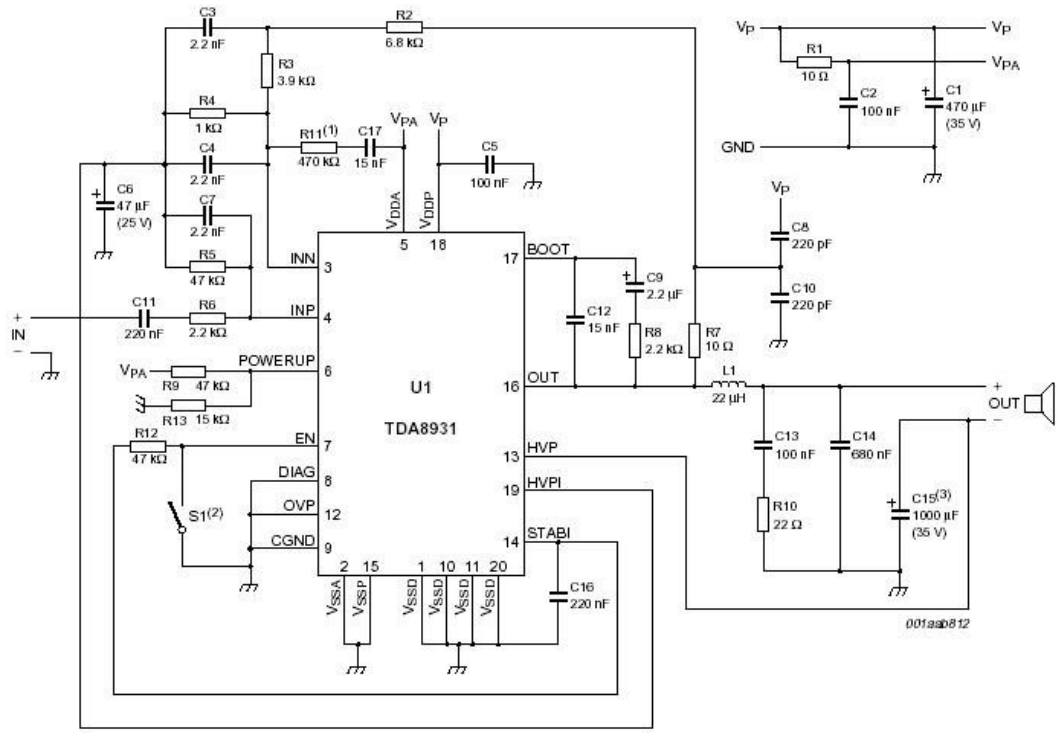
lately i am thinking of using independent high side and low side deivers but have yet to make any progress on that. If i do, I will go your route as well.

in my version of the UcD, the input is upside down from Bruno's AES paper and Phillips' application note. so that the output is all referenced to the negative rail, and the driver chip sits on the negative rail.

作者: 音响DSP **时间:** 2007-10-29 17:50

To Dear Millwood:
能否把下面的TDA8931T应用电路图做个简要分析,因为有些元件看不太懂.谢谢。


图片附件: **TDA8931T application circuit.JPG** (2007-10-29 17:53, 74.97 KB) / 下载次数 132
http://bbs.hifidiy.net/attachment.php?aid=269601&k=81dc87310472f1e273b598673d09941e&t=1266022130&sid=88tt3Q



(1) Optional feed forward network to improve SVRR.

(2) Standby mode: S1 = closed; Operating mode: S1 = open.

(3) The low frequency gain is determined by the capacitor in series with the speaker. The cut-off frequency with a 4 Ω speaker and C15 = 1000 µF is 40 Hz.

Fig 5. Typical application diagram with TDA8931 supplied from an asymmetrical supply

---

作者: millwood **时间:** 2007-10-29 20:17

I will give it a shot.

the chip is a half-bridge construction. the application here is powered by a single rail so you will need to block the DC output.

R1/C1/C2 forms the power supply conditioning circuitry for power (Vp) and analog power (Vpa). R1/C2 and pin 6 forms the soft power on circuitry for the chip.

the low pass filter is L1 / C14, with C13/R10 being the typical zobel network.

HVP provides the 1/2 of Vp (see table 6, pin 13 of the datasheet). this is where I think Phillips is so dumb: they used two power mosfet to generate a dc voltage but they could have easily integrated two gate drivers and get a real full bridge application here. Anyway, HVP outputs 1/2 of Vp and C15 is the filter / DC blocking capacitor (otherwise, HVP would have been shorted to ground).

C12 is the typical bootstrap capacitor to provide the highside driver its supply voltage. table 6, pin 17 shows that the boot capacitor is powered up from STABI (12v internally regulated supply) through a fast recovery diode (in serial with a resistor). c9/r8 is the snobber network to get rid of any overshot on the front of the pwm waveform.

r7/c8/c10 snobs the output as well. r2/r3/r4 and c3 forms the feedback network. when OUT goes high, C3 snobs it and prevents it from showing up on INN (negative input end of the comparator) for a short period of time. As C3 is charged up, OUT stays hi to bring the audio output up through L1/C14. After C3 is charged up, OUT shows up at INN, and begins to surpass the audio input on INP, and the comparator flips, driving OUT to lo, and the cycle continues.

because this is a single rail operation, the chip also uses a pair of mosfet (table 6, pin 19) to form a 1/2 Vpa. that is the HVPI pin. C6 is the snobber on that pin and to feed 1/2 Vpa to the INN and INP. C4/C7 are the snobbers there. this is conceptually similar to how you would do to use opamp on single rail supplies.

C11 is the DC blocking input capacitor.

C16 stablizes STABI (the internal 12v regulator's output pin). R12 / S1 allows for disabling of the chip through pin 7 - if you didn't have R12, closing S1 would short STABI to ground. also please pay close attention to the logic on EN and POWERUP.

the particular set up does not use the over voltage protection pin (pin 12).

Hopefully this helps.

=====here is the translation, courtesy of Yahoo.=====

我将尝试。

芯片是应用这里由唯一路轨供给动力的一半桥梁建筑因此您将需要阻拦DC 产品。

R1/C1/C2 形成电源适应的电路为力量(Vp) 并且模式力量(Vpa) 。R1/C2 和别住6 个形式软的力量在电路为芯片。

低通滤波器是L1/C14, 用C13/R10 是典型的zobel 网络。

HVP 提供1/2 Vp (参见表6, 别针13 datasheet) 。这是我认为的地方菲利普是很沉默寡言的: 他们使用二力量mosfet 引起直流电压但他们能容易地集成了二个门司机和得到一种真正的充分的桥梁应用这里。无论如何, HVP 输出1/2 Vp 并且C15 是过滤器/DC 阻拦的电容器(否则, HVP 会短缺研) 。

C12 是典型的引导电容器提供highside 司机它的电源电压表6, 别住17 表示, 起动电容器从STABI 供给动力(12v 内部调控了供应) 通过一个快速的补救二极管(在连续与电阻器) 。c9/r8 是snobber 网络摆脱任何超越在pwm 信号波形的前线。

r7/c8/c10 snobs 产品和r2/r3/r4 和c3 一样好形成反馈网络当去高, C3 snobs 它和防止它出现在旅店(比较器的消极输入末端) 一个短的时期。如同C3 被充电, 在逗留之外高提出音频输出通过L1/C14。在C3 被充电之后, 出现在旅店, 和开始超过音像输入在INP, 并且比较器翻转, 驾驶到低, 并且周期继续。

因为这是唯一路轨操作, 芯片并且使用一对mosfet (表6, 别针19) 形成1/2 Vpa. 是HVPI 别针。C6 是snobber 在那个别针和哺养1/2 Vpa 对旅店和INP 。这与的C4/C7 是snobbers 那里怎样是概念性地相似您会做使用opamp 在唯一路轨供应。

C11 是DC 阻拦输入电容器。

C16 stablizes STABI (内部12v regulator's 产品别针) 。R12/S1 考虑到失去能力芯片通过别针7 - 如果您didn't 有R12, 关闭的S1 会短缺STABI 并且研取乐对逻辑的薪水密切的关注在EN 和POWERUP 。

特殊设定不使用结束电压保护别针(别针12) 。

有希望地这帮助。

作者: Biglee_163 **时间:** 2007-10-29 20:30

my god!
seams you don't konw chinese at all

作者: scooby **时间:** 2007-10-29 20:49

Individual Class D power amplifier or feel good. High efficiency heating small. Also power-saving. Not many applications before, but now technology is mature. The scope of application or many. He still has the characteristics! Before listening to a friend said Class D power amplifier can ever heard. We have the opportunity to listen to ... estimated themselves to be a not very poor.

作者: Biglee_163 **时间:** 2007-10-29 20:53

> 原帖由 *scooby* 于 2007-10-29 20:49 发表
> Individual Class D power amplifier or feel good. High efficiency heating small. Also power-saving. Not many applications before, but now technology is mature. The scope of application or many. He ...

这段英文我实在是看不懂了

作者: gogowatch **时间:** 2007-10-29 23:06

I have built a power amp using Hypex UCD180. It sounds great.

Cheers,

作者: FUMAC **时间:** 2007-10-30 05:02

Individual Class D power amplifier or feel good. High efficiency heating small. Also power-saving.
Not many applications before, but now technology is mature.
The scope of application or many.
He still has the characteristics! Before listening to a friend said Class D power amplifier can ever heard. We have the opportunity to listen to ... estimated themselves to be a not very poor.

有部分D类功放感觉还是不错的, 高效率,低热量, 节省能源,
在此之前,并没有很多成熟的产品出现,但是现在不一样了,技术已经很成熟.可以适应不同的用途.
D类是有他自己独特的特点.
在听D类之前, 曾经听过一个朋友有说起,
我们有机会听了后发现d类功放并不是很糟糕.

大概这个意思,只做翻译,不代表本人观点,翻译错误请指正,本人在学英语

作者: FUMAC **时间:** 2007-10-30 05:32

will give it a shot.

the chip is a half-bridge construction. the application here is powered by a single rail so you will need to block the DC output.

这个是一个半桥的结构, 这个电路使用单电源,所以加入了一个隔直电容

R1/C1/C2 forms the power supply conditioning circuitry for power (Vp) and analog power (Vpa).

R1/C1/C2 为供电滤波

R1/C2 and pin 6 forms the soft power on circuitry for the chip.

R1/C2 和pin 6 组成软启动电路

the low pass filter is L1 / C14, with C13/R10 being the typical zobel network.
---L1/C4为低通滤波器, C13/R10是一个销振网络.

HVP provides the 1/2 of Vp (see table 6, pin 13 of the datasheet).
this is where I think Phillips is so dumb: they used two power mosfet to generate a dc voltage but they could have easily integrated two gate drivers and get a real full bridge application here.
Anyway, HVP outputs 1/2 of Vp and C15 is the filter / DC blocking capacitor (otherwise, HVP would have been shorted to ground).

HVP 提供1/2电压 (请看 table 6, pin 13 of the datasheet).
个人认为飞利浦在这里非常愚蠢,他们使用两个MOSFET去产生直流电压,但是如果做多两个驱动,那么他就可以得到一个全桥的D类芯片.
(fumac个人认为,全桥并不是一个理想的结构,500w以下,半桥结构可以做的很好,以下为广告时间:比如FUMAC 的 MHZ class-d 500w还是半桥结构 ,).

继续: HVP输出半电压,C15隔直电容,否则HVP就短路对地了(FUMAC的理解,此电容除了隔直外,另一个作用是HVP的滤波电容,呵呵,很古怪的做法)

C12 is the typical bootstrap capacitor to provide the highside driver its supply voltage. table 6, pin 17 shows that the boot capacitor is powered up from STABI (12v internally regulated supply) through a fast recovery diode (in serial with a resistor).
---
c12 是标准的自举电容, 用于上臂驱动电路供电. 表6说明:17脚, 此电容供电通过一个快恢复二极管串联一个电阻后连接到内部12v稳压输出口 STABI

c9/r8 is the snobber network to get rid of any overshot on the front of the pwm waveform.

C9R8是阻尼网络,用于消除PWM过冲的干扰

欲知后事如何,请看下回分解

作者: millwood **时间:** 2007-10-30 05:49

fumac, are you selling your module? it would be quite marketable.

作者: FUMAC **时间:** 2007-10-30 05:57

yes, i'm also finding a agent at usa, i'm selling my modules and compelete one. ;)

作者: FUMAC **时间:** 2007-10-30 06:38

r7/c8/c10 snobs the output as well.
---
r7/c8/c10输出销振电路

r2/r3/r4 and c3 forms the feedback network. when OUT goes high, C3 snobs it and prevents it from showing up on INN (negative input end of the comparator) for a short period of time. As C3 is charged up, OUT stays hi to bring the audio output up through L1/C14. After C3 is charged up, OUT shows up at INN, and begins to surpass the audio input on INP, and the comparator flips, driving OUT to lo, and the cycle continues.
---
r2/r3/r4 and c3 是反馈电路, 当输出为高的时候, C3 将充电,在此极短时间,阻止了信号进入比较器的反向输入口(INN),当C3充电完成后,输出信号进入INN,引起比较器的反转,于是输出为低电平,如此往复,电路就正常工作了

because this is a single rail operation, the chip also uses a pair of mosfet (table 6, pin 19) to form a 1/2 Vpa. that is the HVPI pin. C6 is the snobber on that pin and to feed 1/2 Vpa to the INN and INP. C4/C7 are the snobbers there. this is conceptually similar to how you would do to use opamp on single rail supplies.

因为这个是一个单电源回路, 芯片采用双MOS输出半电压(前面说过),C6 是输入端基准电压的滤波, 这个基准电压由HVPI引脚提供,这个和OP工作在但电压电路上类似的结构(其实OP和比较器原理上区别不大,侧重点不同. fumac注)

C11 is the DC blocking input capacitor.

C11输入端隔直电容

C16 stablizes STABI (the internal 12v regulator's output pin). R12 / S1 allows for disabling of the chip through pin 7 - if you didn't have R12, closing S1 would short STABI to ground. also please pay close attention to the logic on EN and POWERUP.

C16是内部12v稳压输出的滤波电容.(stabi). R12 / S1组成芯片的使能控制,如果没有R12将会让内部稳压输出对地短路,同时,应该注意EN和上电的逻辑关系.

the particular set up does not use the over voltage protection pin (pin 12).

这个电路并没有使用过压保护功能(pin12)
fumac:过压保护一般并不需要,因为功放设计的时候,成熟的工程师都充分考虑到电压的波动,
但是对于DIY 最好还是加上过压保护吧,因为diyer手头上的变压器参差不齐,电压也不一定完全符合安全设计的要求..
以下为广告时间:FUMAC的MCD都有过压保护,

----下次不干翻译了,累!

作者: 音响DSP **时间:** 2007-10-30 09:23

嘿嘿，有广告时间给你去给大家普及下这里讨论的迟滞振荡，而不是常规见到的三角波做基准，输入正弦波，通过比较器输出PWM波的。
我也早在2年前就看过TDA8931T的应用电路图，觉得有点不完善。现在有TFA9810T，我也会把它的应用电路和内部结构贴出来让大家再对比，多对比，大脑有思考，才不会觉得累和迷惘。
TFA9810内部结构简图

应用电路，比TDA8931T的简单多了。


图片附件: **TFA9810 Block diagram.JPG** (2007-10-30 10:19, 67.59 KB) / 下载次数 115
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6 BLOCKDIAGRAM

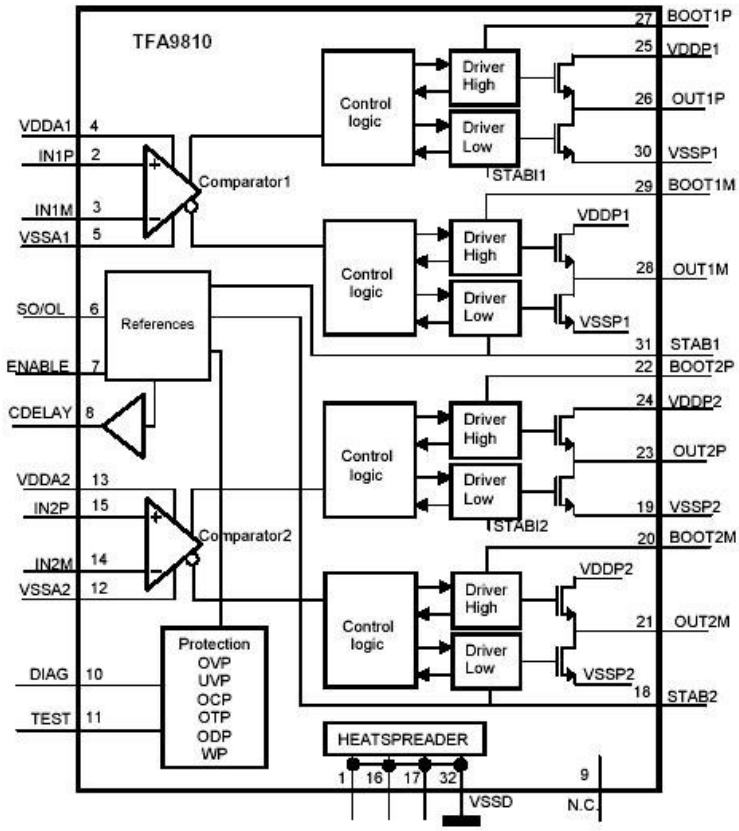

Figure 1. Block diagram

图片附件: **TFA9810 26dB application circuit.JPG** (2007-10-30 10:19, 88.83 KB) / 下载次数 118
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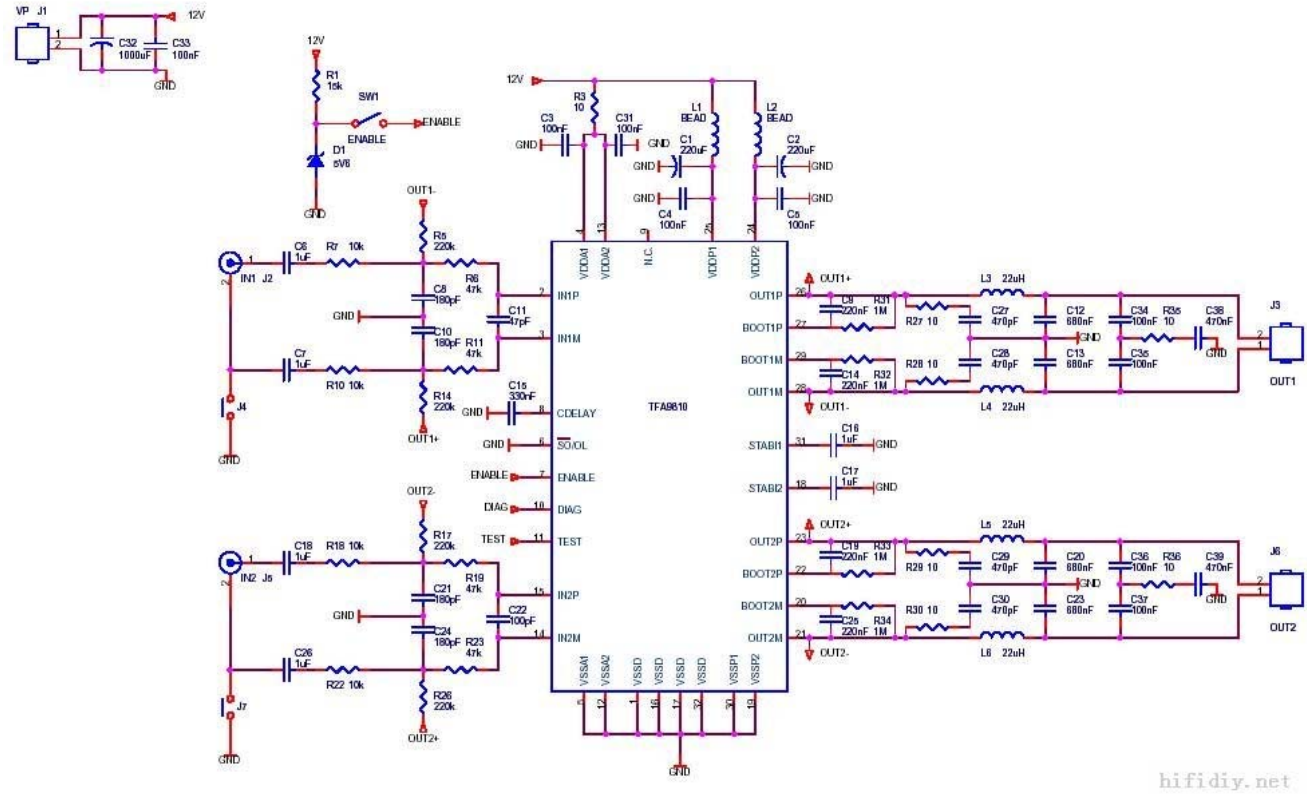

作者: younglee **时间:** 2007-10-30 10:18

Class D 虽然是开关电路，但技术的成熟会慢慢好听起来的！

作者: scooby **时间:** 2007-10-30 10:20

In the past, read the book. Class D power amplifier protection are very good. Personal opinion. Protection circuit or necessary.

作者: younglee **时间:** 2007-10-30 10:39

LM4682 - 10 Watt Stereo CLASS D Audio Power Amplifier with Stereo Headphone Amplifier and DC Volume Control
Parametric Table expand

Parametric Table collapse

Power@ 8Ohms, 1% THD 6 Watt
Power@ 8Ohms, 10% THD 8 Watt
THD 0.2 %
PSRR 94 dB
Channels 2 Channels
THD Conditions Po=6W/channel,fin=1kHz
PSRR Conditions Vrip=200mVpp, 1kHz,Vin=0,input referred,f=60Hz

Power@ 8Ohms, 1% THD 6 Watt
Power@ 8Ohms, 10% THD 8 Watt
THD 0.2 %
PSRR 94 dB
Channels 2 Channels
THD Conditions Po=6W/channel,fin=1kHz
PSRR Conditions Vrip=200mVpp, 1kHz,Vin=0,input referred,f=60Hz
User Supply 12 Volt
Shut down Yes
Shutdown Type Low
Supply Range +9 - +14V
Temperature Min -40 deg C
Temperature Max +85 deg C
View Using Catalog

Typical Performance

---

click for larger image

作者: younglee **时间:** 2007-10-30 10:41

LM4682 - 10 Watt Stereo CLASS D Audio Power Amplifier with Stereo Headphone Amplifier and DC Volume Control
Parametric Table expand

Parametric Table collapse

Power@ 8Ohms, 1% THD 6 Watt
Power@ 8Ohms, 10% THD 8 Watt
THD 0.2 %
PSRR 94 dB
Channels 2 Channels
THD Conditions Po=6W/channel,fin=1kHz
PSRR Conditions Vrip=200mVpp, 1kHz,Vin=0,input referred,f=60Hz

Power@ 8Ohms, 1% THD 6 Watt
Power@ 8Ohms, 10% THD 8 Watt
THD 0.2 %
PSRR 94 dB
Channels 2 Channels
THD Conditions Po=6W/channel,fin=1kHz
PSRR Conditions Vrip=200mVpp, 1kHz,Vin=0,input referred,f=60Hz
User Supply 12 Volt
Shut down Yes
Shutdown Type Low
Supply Range +9 - +14V
Temperature Min -40 deg C
Temperature Max +85 deg C
View Using Catalog

Typical Performance

---

click for larger image

作者: younglee **时间:** 2007-10-30 10:45

专门做数字功放(CLASS D)方案,产品系列较全,可满足小功率的1W到3W的需求,也可满足4W到15W大功率的要求.尤其是我司能提供成本较低的2.1的方案.具体产品如下:
2W至3W的有:TMPA2155DS 这个产品已广泛使用,它有单通道也有双通道
4W至6W的有:TMPA401DS 它也有单通道和双通道
10W以上的有:TMPA420DS 15W*2
2.1音响方案:TMPA421 15W+12W*2

作者: younglee **时间:** 2007-10-30 10:56

电子百科 :
D类放大器的工作原理

D类放大器是一种完全不同的放大器，其实称之为D类放大器似乎并不恰当。因为它并不只是放大器工作点的选择。所以也有人称之为“数字音频放大器”。似乎这个名称更为恰当。因为有一种D类放大器可以接收数字输入而省去D/A变换。

D类放大器所采用的技术其实就是脉宽调制技术PWM(Pulse Width Modulation)。所谓脉宽调制技术也就是把模拟音频信号的幅度来调制一系列矩形脉冲的宽度。这样，一个模拟音频信号就变成了一系列宽度受到调制的等幅脉冲信号。为什么要这样做呢？因为这时候，要把信号放大，只要对这系列的脉冲信号放放大就可以了。而原来的模拟信号并不是包含在这个脉冲信号的幅度之中，而是包含在它的宽度之中。只要把这个放大以后的脉宽调制信号中所包含的低频分量滤出来就可以得到放大以后的音频信号。在没有信号的时候，输入信号就是对称方波。所以如果在放大的时候，幅度上产生失真并不会使原来的音频信号产生失真。在这种情况下的放大器就可以完全工作在开关状态。在开关工作状态，晶体管的效率是很高的。因为在完全导通的时候晶体管的电流很大但是压降很小(由其饱和电阻决定)，而在截止的时候，加在晶体管的电压很高，但是流过晶体管的电流很小(只是其漏电流而已)。同时还可以使晶体管在没有音频信号时完全工作在截止状态，这样其效率就更高。这种脉宽调制可以用一个等幅三角波来对音频信号进行采样。为了避免失真这个三角波的频率必须远高于音频信号的最高频率分量。

D类放大器的特点
它的最大特点就是它能够在保持最低的失真情况下得到最高的效率。

D类放大器的发展趋势
传统的D类放大器在通过功率MOSFET进行放大前，需使用一个控制器将模拟或数字音频转换为脉宽调制(PWM)信号，这个控制器一般集成在一个功率后端器件当中。这类放大器拥有高效率的优点，可采用小型(或不使用)散热器，并降低电源输出的功率要求。然而，与传统的A类和B类放大器相比，这类放大器在成本、性能和电磁干扰(EMI)等 方面的存在着固有的系统问题。今后D类放大器将朝着解决这些问题的

方向发展。

1 降低辐射EMI 2 改善音质 3 降低系统成本 4 电源抑制反馈

几类放大器的区别

所有这些放大器的区别只是在于静态工作点的选择。A类放大器具有最大的静态工作电流，也就是它在没有输入信号的时候也会消耗电流，因而显然它的效率是最低的。但是，只要选择合适的工作点，它通常具有最低的失真。B类放大器则选择了50%的导通时间，它的效率肯定比A类放大器要高,但是失真也要严重很多。AB类放大器则是介于A类和B类之间。它的导通时间也是介于50%到100%之间。C类放大器是指那些导通时间小于50%的放大器，通常用于负载为调谐回路的射频放大器中。

作者: millwood **时间:** 2007-10-30 19:52

> 原帖由 *音响DSP* 于 2007-10-30 09:23 发表
> 嘿嘿，有广告时间给你去给大家普及下这里讨论的迟滞振荡，而不是常规见到的三角波做基准，输入正弦波，通过比较器输出PWM波的。
> 我也早在2年前就看过TDA8931T的应用电路图，觉得有点不完善。现在有TFA9810T，我 ...

looks like tfa9810 addresses the half-bridge output issue of the tda8931.

Looks like a very promising chip. Unfortunately, I have yet to find anyone carrying it, probably because it is fairly new - the datasheet is dated 8/30/07.

作者: 音响DSP **时间:** 2007-10-31 09:18

millwood, TFA9810T已经发布1年了，在国内的几大电视机厂已经有1年的出货历史了,每个月都超过2百万片的出货量。NXP的D类功放有什么新东西，我都能第一时间拿到。因为NXP有我的好朋友负责audio的技术支持，如果你有什么问题，都可以提出来，非常感谢你的评论。

IR2092是个analog in的D类驱动IC。我也会打算找个IC来玩玩。

作者: FUMAC **时间:** 2007-11-2 18:32

两天就冷下来了, 估计还是兴趣不大,隔壁帖子有个朋友想好好学D类,这个帖子就不错也,既能学D类,还可以学英文

作者: gogowatch **时间:** 2007-11-7 18:48 **标题:** 文章推荐

文章推荐

Reducing Ground Bounce in DC-to-DC Converters—Some Grounding Essentials

http://techonline.com/article/pdf/showPDFinIE.jhtml?id=2024020631

作者: 音响DSP **时间:** 2007-11-7 19:07

TFA9810 demo板上做了个小小的实验。12V 8欧姆 BTL
这个是TFA9810 DEMO板上 1KHz 1W的THD+N

这个是TFA9810 DEMO板上增加了滤波器后反馈 1KHz 1W的THD+N

这个是TFA9810 DEMO板上 10KHz 1W的THD+N

这个是TFA9810 DEMO板上增加了滤波器后反馈 10KHz 1W的THD+N

这个是TFA9810 DEMO板上 20KHz 1W的THD+N

这个是TFA9810 DEMO板上增加了滤波器后反馈 20KHz 1W的THD+N

这里解释下输入信号是以TFA9810 DEMO板上 1KHz 1W/8欧姆的THD+N为基准，在10KHz、20KHz出现小峰，是滤波器效应。而在滤波器后负反馈就有降低此峰的作用，同时减小了失真。
同时，在示波器上也可以看到残留载波信号的幅度小了1/3，可惜没把示波器的图给记录下来。各位可以在实验中去验证。

NXP的应用工程师告诉我，UCD方式在高频的时候，由于增益比较小，所以比较难起振，所以有些仿真软件跑不起来也是有道理的。嘿嘿。

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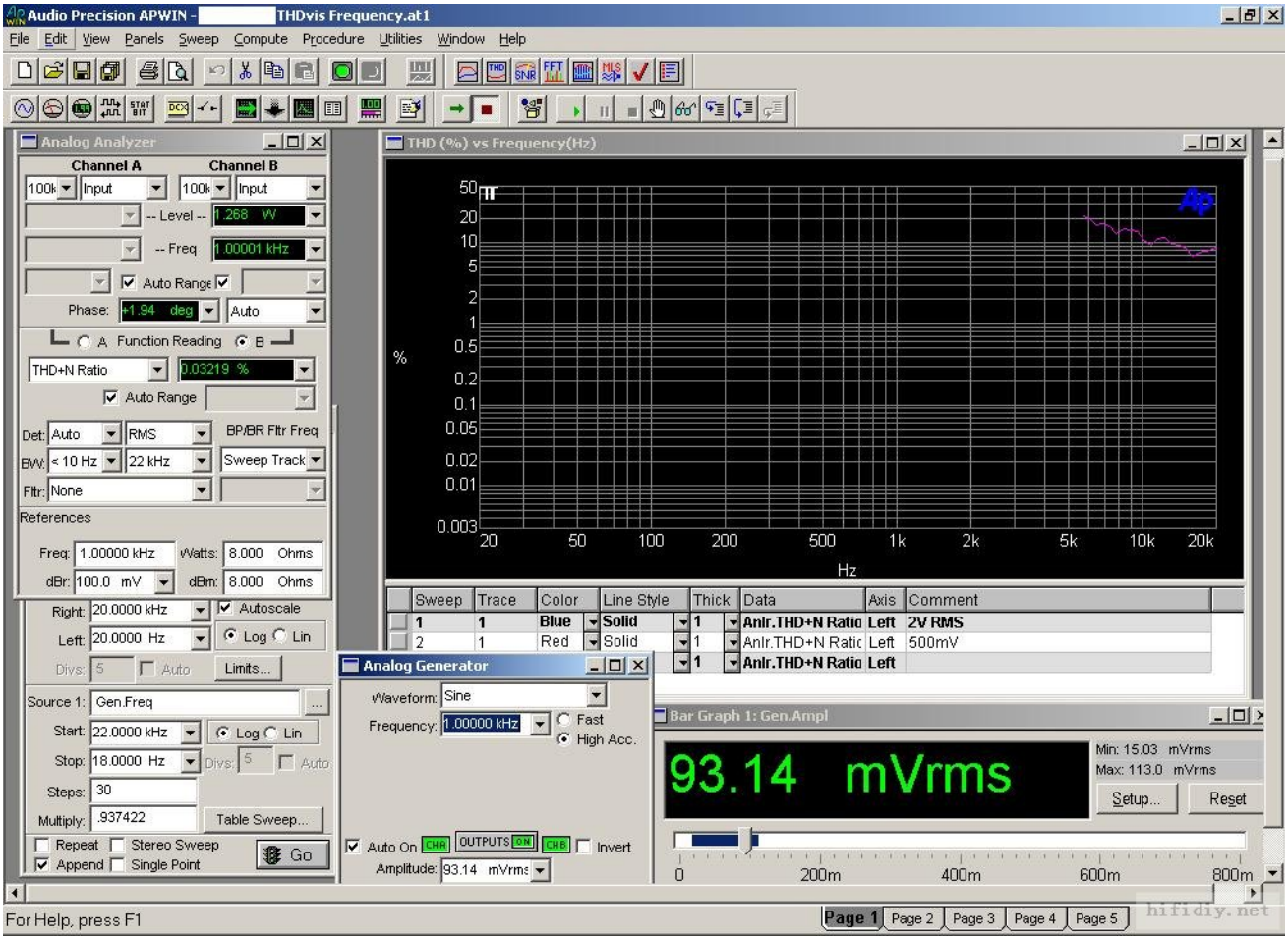

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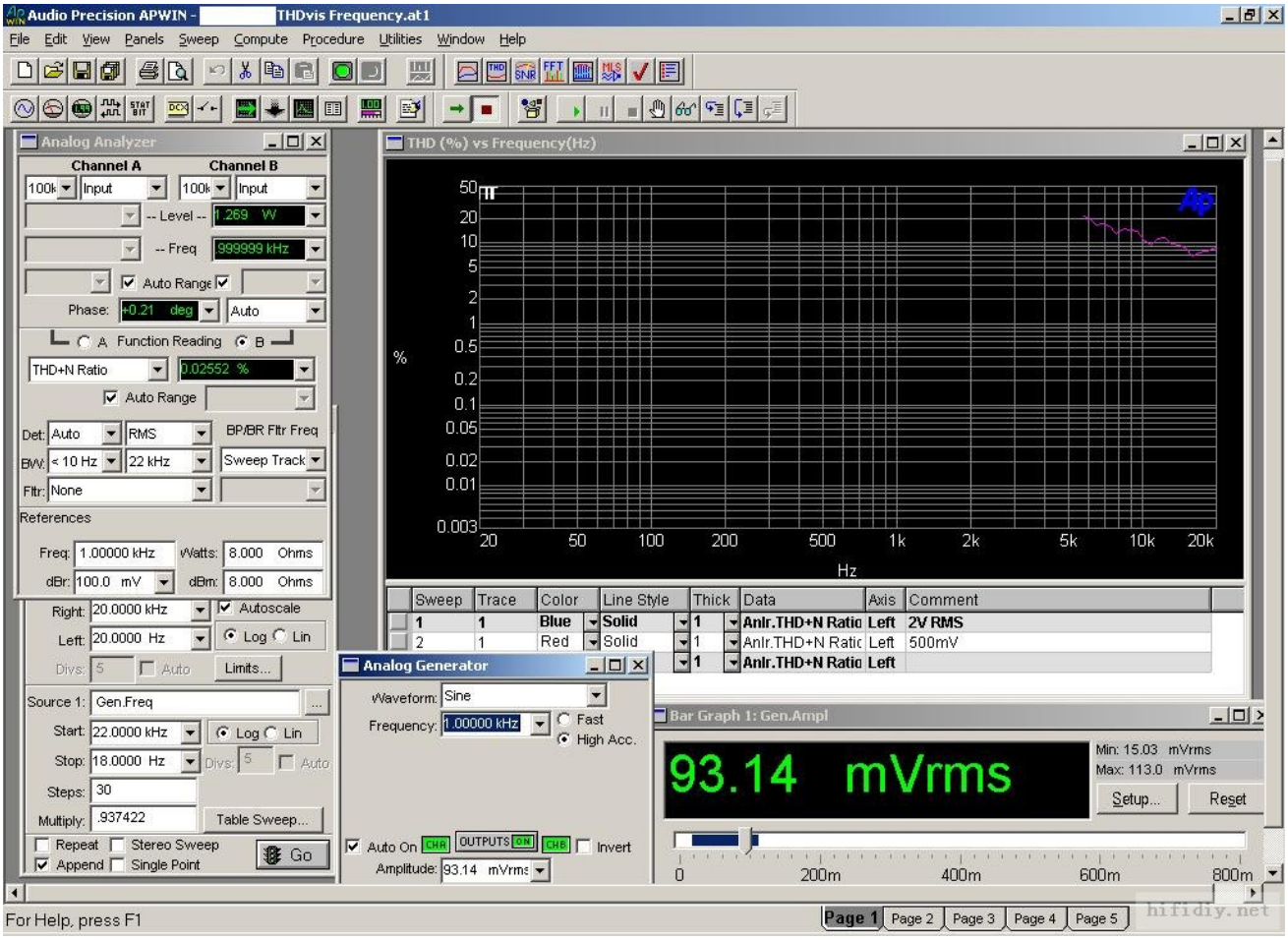

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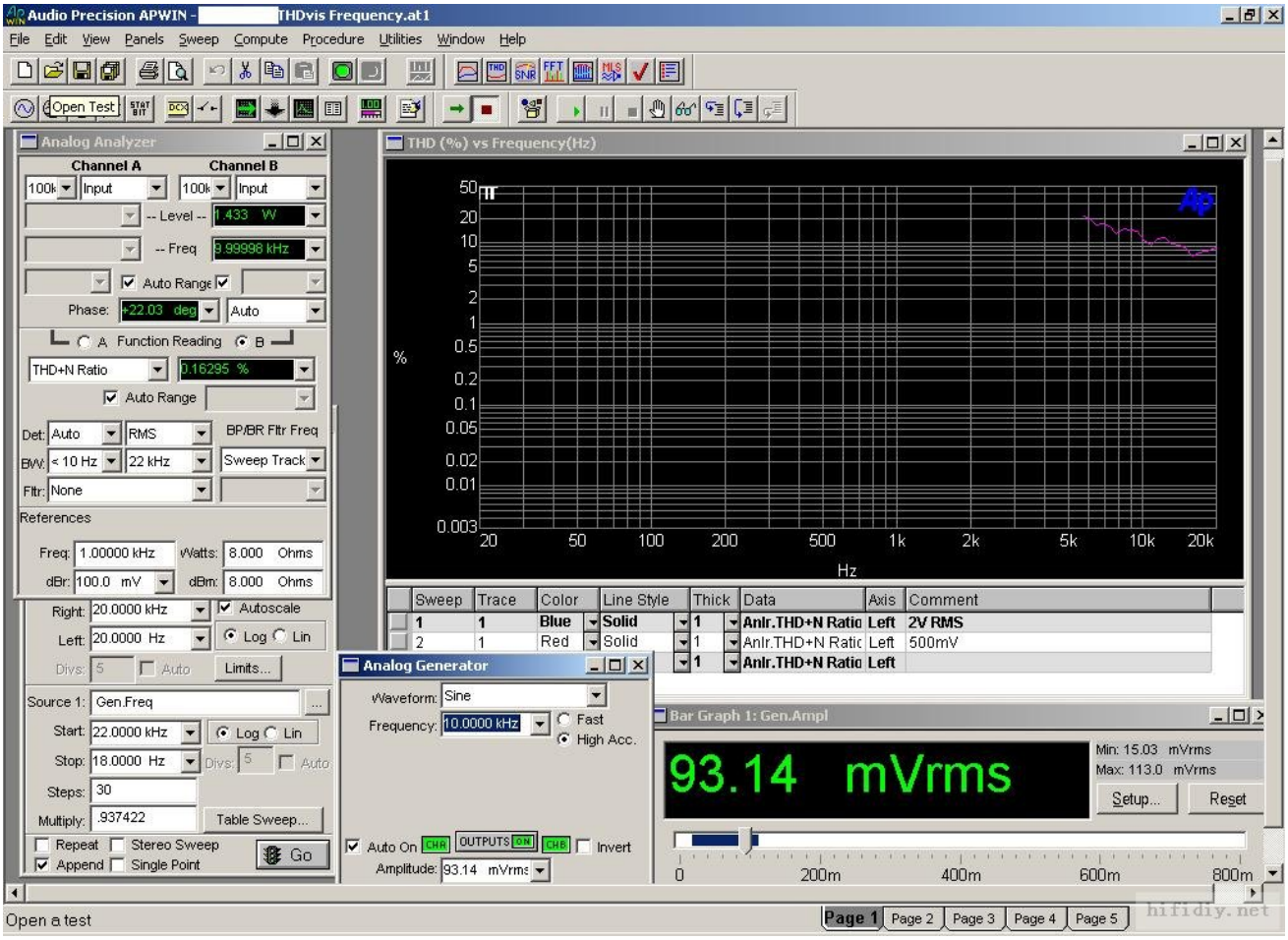

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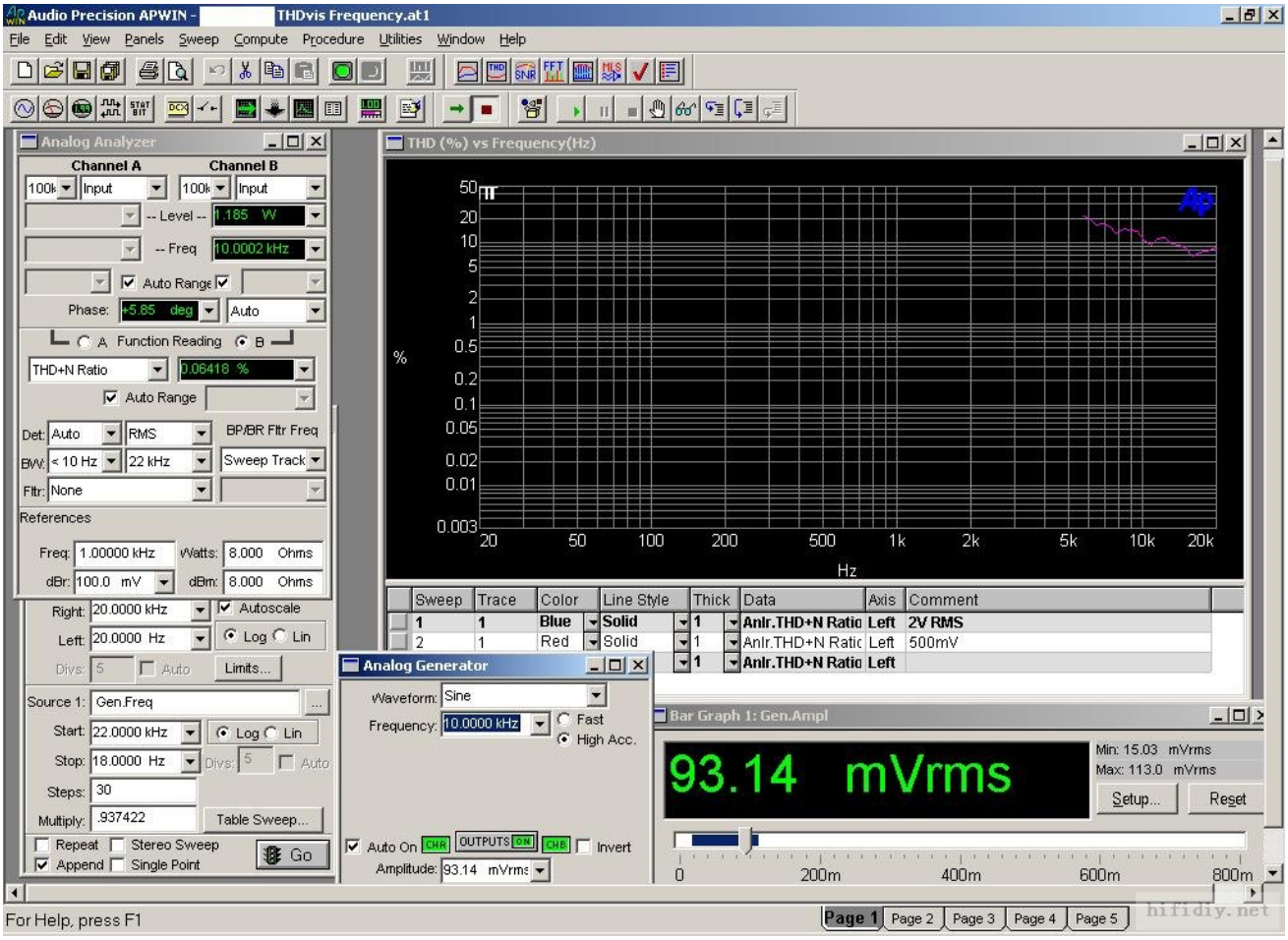

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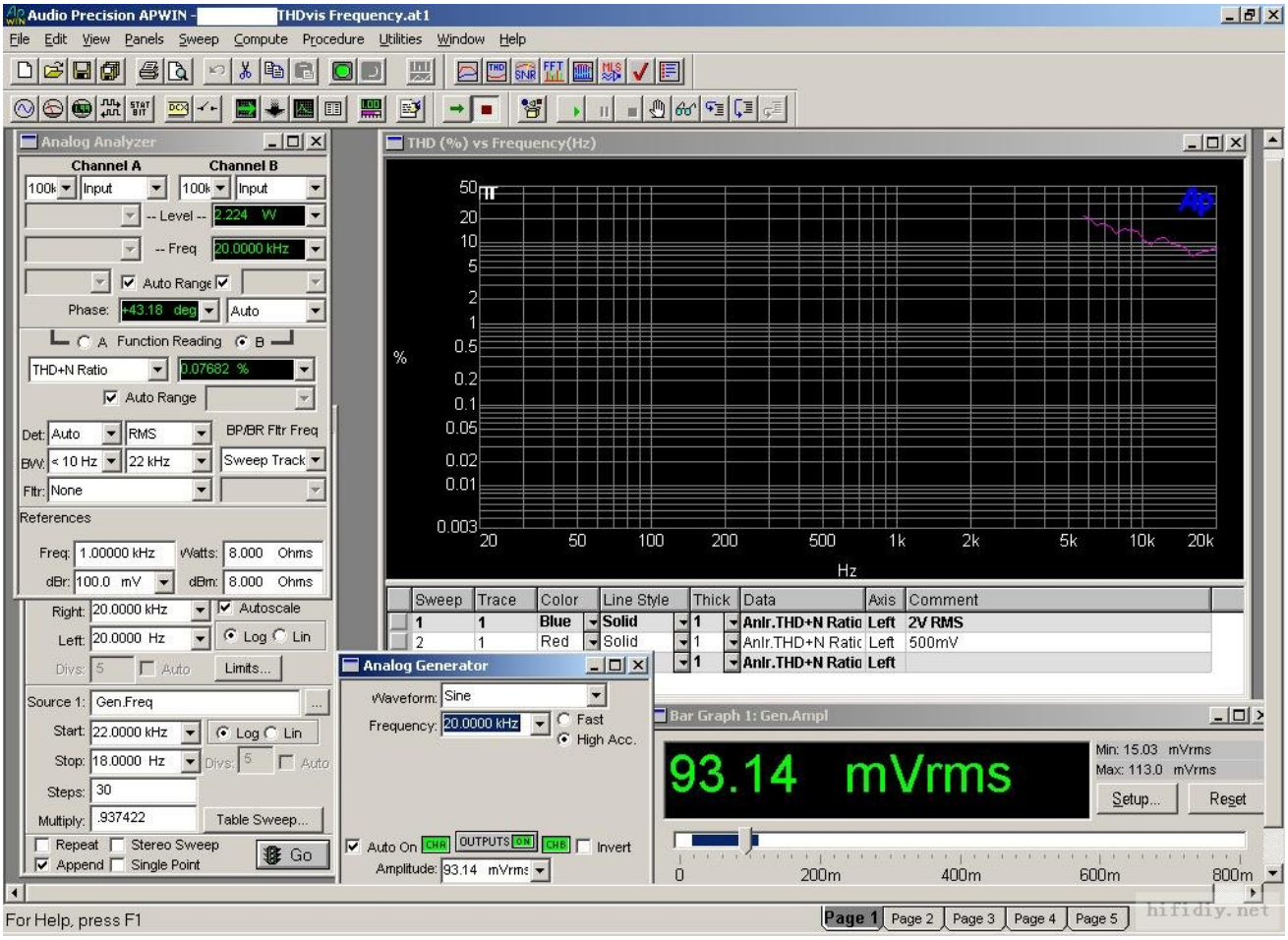

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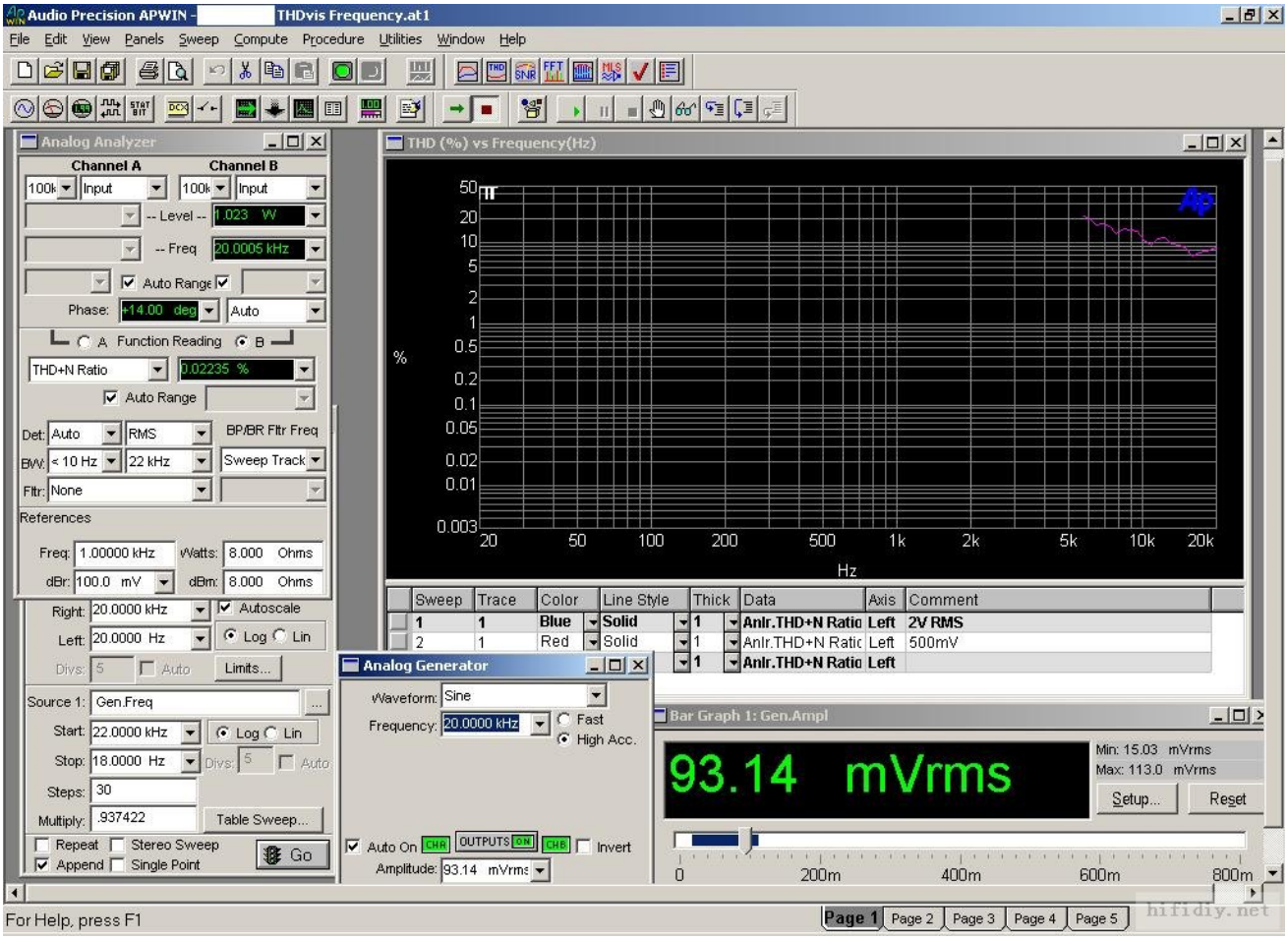

作者: 音响DSP **时间:** 2007-11-7 19:21

下次在TDA892X DEMO板上做个实验，再测试下。这几天在家优化下后滤波器的反馈超前网络。

作者: 音响DSP **时间:** 2007-11-9 21:40

millwood怎么不出现呢?

作者: millwood **时间:** 2007-11-9 22:57

I am still here, .

a little bit busy now so will digest your stuff over the weekend. looks great.

作者: 剑心 **时间:** 2007-11-12 11:48

你的滤波前后双路反馈是啥样？我的也是滤波前后双路反馈

> 原帖由 *FUMAC* 于 2007-10-25 12:03 发表
> 从反馈角度而言有，无反馈，滤波前反馈（IR），滤波后反馈（UCD），滤波前后双路反馈（小弟的MCD），还有数字反馈（D2AUDIO）

作者: FUMAC **时间:** 2007-11-20 02:55

为了感谢millwood 顶上来

作者: 音响DSP **时间:** 2007-11-20 09:05

我的就是滤波前后都有反馈。
按照发布UCD原理的AES论文，4阶有源反馈网络的指标更好。技术储备已经准备好了，明年打算用DSP去做滤波和修正，获得更好的性能。

作者: gogowatch **时间:** 2007-11-20 10:31

请音响DSP 可否介绍一些用DSP做滤波和修正的原理,手段的文章, 谢谢.

作者: 音响DSP **时间:** 2007-11-20 18:09

Ground Bounce in DC-to-DC Converters的确是个大问题，同样道理，在大功率D类功放上。

至于一些介绍用DSP做滤波和修正的原理,手段的文章，个人也在摸索阶段。其实原理是非常简单，LC是滞后，需要超前移相器去补偿，甚至需要BPF去限制反馈信号的带宽。一般的运放是不够的，如果用高精度宽带的音频运放去，已经超过3个美金了，那还不如用ADAU1702。DSP非常好，想修改相位就修改相位，想修改幅度就修改幅度，不象常规的运放滤波器，幅度和相位是难以分开的。

作者: gogowatch **时间:** 2007-11-20 21:00 **标题:** 回复 #96 音响DSP 的帖子

谢谢音响DSP的介绍. 我会自己找一找参考资料, 找到的话再与大家分享.

作者: millwood **时间:** 2007-11-25 02:55

音响DSP ,

sorry for the delay in getting back to you.

great stuff that you are working on.

there has been constant debate among class D devotees as to the merits of pre-filter feedback and post filter feedback. What you have proven is that one can have his cake and eat it at the same time.

the two topologies are quite similar and the same amp can be configured both ways.

I personally find the post filter feedback quite appealing but unfortunately I don't have access to the NXP chip to do anything with it. the IRF chip is not available yet in the US - we are behind the rest of the world sometimes.

Great. Thanks for sharing.

BTW, the output power of the chip is quite small. Has anyone tried to use the output pins to drive a mosfet driver (half or full bridge) + mosfets? you can either run the mosfet driver out side of the feedback loop or inside the feedback loop.

作者: 音响DSP **时间:** 2007-11-26 10:20

pre-filter NFB能避免UCD post-filter NFB不能容易起振的bug。如果2者都能用是最好不过了。依然要注意的是，post-filter的RC网络要选择合适。否则低频和中频段的增益过低。

I am trying the mosfet driver +FETFET(TOTEM outputtopology), for the reason of more expensive IR chips and FETs.
For me, NXP's is easily to get than IRF's.

作者: FUMAC **时间:** 2008-2-23 16:47

millwood 新年好,很久没见你上线了
