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## [Building an LPT DAC](#)

- Created: 9th Mar 2012
- [Comments \(0\)](#)
- Tags: [retro](#)

So well, let's build an LPT DAC! What is this first, what it can give? In short this was the "poor man's sound card" in the early 90's, a simple solution giving you a decent 8bit mono digital output if carefully assembled from the proper parts. Of course it won't be a Sound Blaster, only a few games, MOD players and trackers support it, but if you have these, it can be a nice add-on especially for those old brick notebooks not having any advanced sound support.

### Software support

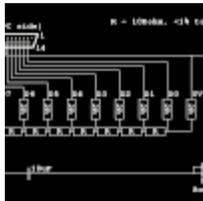
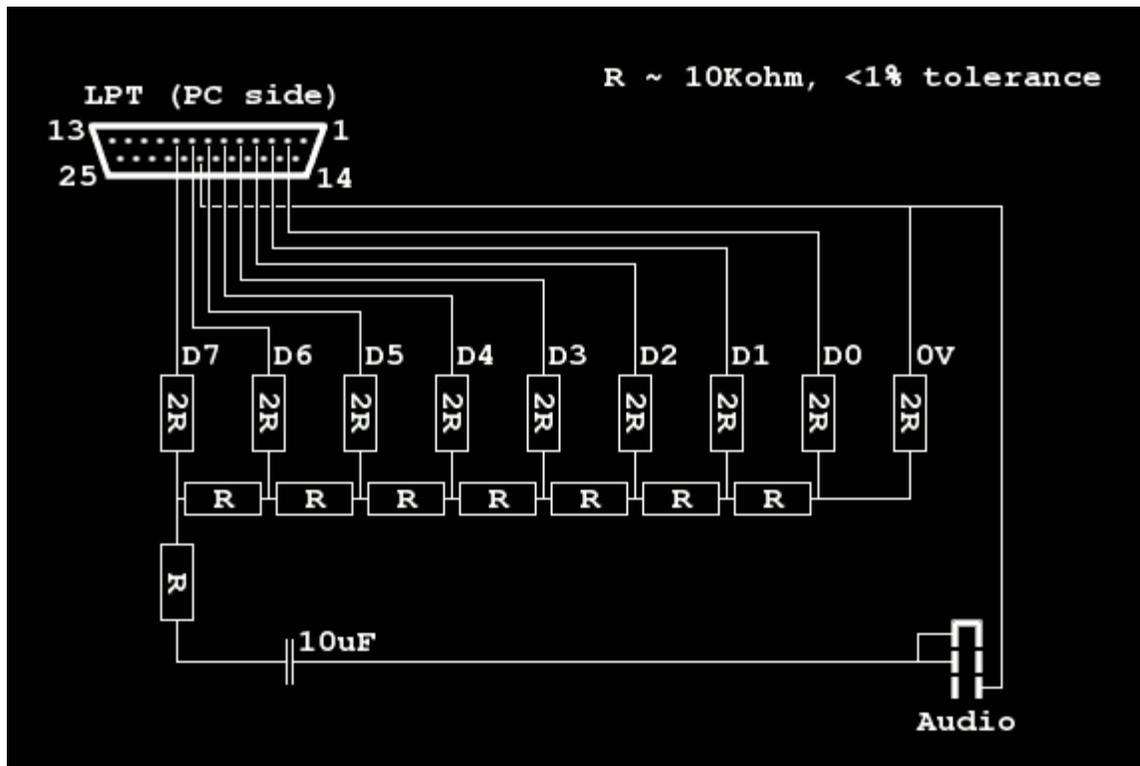
First of all, what software support will you get once you build one? This list is not complete, just gives some notable examples:

- Galaxy Music Player (1.2), [downloadable from SAC](#). From all MOD players I tried this has the thinnest requirements, it can play 4 channel mods at 36KHz fine on my 20MHz 3.86 powered Chicony notebook.
- Impulse Tracker, [official site](#). Well, if you not only want to listen, but to edit MODs as well. This has a bit steeper requirements.
- Pinball Fantasies, a very good pinball game. You may find it on practically any abandonware site.
- Virtual Sound Blaster (Andrew Zabolotny), [downloadable with source](#). This software (binaries are in /sbemu/ready) will emulate the digital output of a Sound Blaster card on an LPT DAC. It might actually work.

Note that some old software may refer to an LPT DAC by the name Covox or Covox Speech Thing (This thing was manufactured and sold under this name back then) or Disney Sound Source (This was something a bit more complex than a plain DAC, but the plain DAC should work too with these).

### So what do you need? - Part list

The LPT DAC is actually a very simple peripheral, all the components it will need will probably cost less than an euro. You should however pay attention to a few things to get a decent sound quality. The circuit diagram is down here, so first, let's get down to business, then the explanations:



- Title: [LPT DAC circuit](#)
- Created: 27th Jun 2009
- [Comments \(0\)](#)
- Tags:
- A circuit diagram for building an LPT DAC, presentation is own work, intellectual property comes from several internet sources.

### [LPT DAC Circuit diagram](#)

- At least 30 1% tolerance or better resistors between 8KOhms and 16KOhms (All the same).
- An at about 10-20uF electrolyte capacitor.
- A 25pin male D connector.
- A female audio connector.
- Some box or anything to hold that bunch of stuff once you solder it together.
- Soldering equipment.
- Some multimeter or anything to measure the resistors (Optional).

Note that the resistance values are actually not much important. Just take what the vendor has somewhere in this range at 1% or better accuracy. Don't go below since then the probable internal resistances of the LPT port's pins will deteriorate output quality, while going way higher will bring in the effect of the non-infinite resistance of a connected speaker amplifier (Note: Only using resistances below at about 1KOhms would become probably harmful to the LPT port's circuits).

### Assembly

So why use equivalent resistors and why measure them?



- Title: [LPT DAC ohms](#)
- Created: 6th Jun 2011
- [Comments \(0\)](#)
- Tags:
- Measuring the resistors for building my LPT DAC. Hopefully it did worth, I can't tell as I only built one, which one's sound quality is quite satisfactory.

Usually when you acquire a set of resistors they typically come on a sheet, so were manufactured in one run (If possible, try to ask the vendor to give you them on one continuous sheet to be sure). These resistors are typically very close to each other in resistance, so you may actually get significantly better results than what the tolerances suspect. This answers the question on why to create the  $2R$  resistances from two  $R$  resistances: This way your  $2R$ 's will be really the duplicate of  $R$ 's. The role of measuring the resistors is to tune it a little further: The actual accuracy of the multimeter does not even matter much, if it can produce a stable result, it is fine for the purpose. Remember, you only have to get the resistances correct relative to each other, not against some set value. First you separate the best of your resistors for the DAC, then make pairs for  $2R$ 's from the low end and high end resistance values: this ensures you used your resources the best for the best possible sound quality.

That little  $10\mu\text{F}$  capacitor acts as a high-pass filter: It's only role is to remove DC offset in case the DAC was left in some nonzero state for long. By the circuit above it's actual cutoff frequency is indeterminable (It would need a load resistance), if you connect an amplifier with an internal resistance in the range of  $100\text{K}\Omega$ 's it would cut off at approx  $1/6\text{Hz}$ . If you want by adding a large load resistor ( $100\text{K}\Omega$ 's or so) you may tune the cutoff, or might add a low pass filter too to clean off some digital noise. I don't think it would worth though (The added load will deteriorate the quality of the ladder DAC).

The resistance sitting just before the capacitor does not contribute much to the output quality (It truly has no effect at all), however it is important as being in series with the audio jack it protects your LPT port from anything shorting the jack (Most importantly when you plug your speakers in). It also protects your stuff in case one tried to hook up a passive speaker to it (Passive speakers has an impedance in the range of a few ohms, so in practice they are short-circuit for this purpose. You won't get any sound from those of course).

Well, this is probably all what can be said on the project.



- Title: [LPT DAC done](#)
- Created: 28th Apr 2011
- [Comments \(0\)](#)
- Tags: [retro](#)
- My LPT DAC as done. It is sitting on the top of an Enterprise 128K machine.

Carefully solder these stuff together as the circuit diagram tells, then to be sure, probably measure the resistances again

(Some bad soldering might add some unwanted resistance). If you did it right, you might get a nice 6-8bit output depending on your resistors and how the thing was assembled. Finally put this all in some container, maybe a little better than mine here :) - well, it works, then who cares?

## Verifying

So how to verify that the bunch of stuff you soldered together does it's job? It is actually quite simple. You will just need the cheap multimeter probably used before for measuring the resistances. Put it in voltmeter mode, and connect one of it's terminals to ground (Some wire coming from pin 20 of the LPT port, ending in the audio jack ground), the other just before the filtering capacitor (As the capacitor would filter out DC what you will want to measure here).

Then probably that old piece of computer you wanted to use it with has Quick Basic somewhere, at least if it still runs MS DOS, it should have. Create some code among the lines of this:

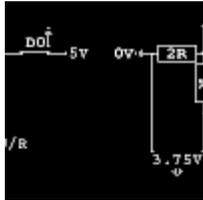
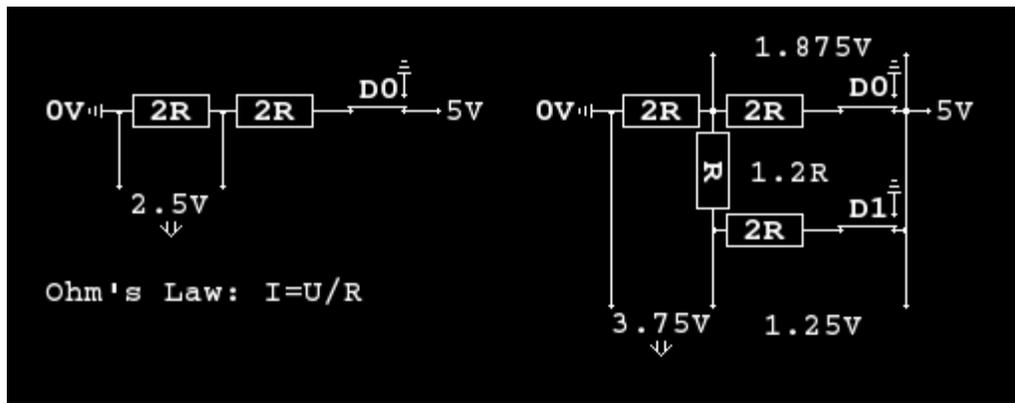
```
' LPT - DAC tester
i = 0
j = 0
WHILE INKEY$ <> "x"
  OUT &H378, i
  j = j + 1
  IF j = 1000 THEN
    j = 0
    i = i + 1
    IF i = 256 THEN i = 0
  END IF
WEND
```

Adjust the speed (by the IF j=1000 statement) to your needs: you should set some rate so each step will output for at least at about 2-3 seconds so your voltmeter may stabilize on it. Run the program, and look at the meter's display. It should show slowly increasing voltage until at about 4,5 or so volts, then starting over from zero. Check how smooth is this incrementing: If all values nicely follow each other in an incremental pattern, you got a true 8 bit DAC (Mine does so, so it is possible if you take care when doing the job). You may also attempt to check linearity too once you are here, but that shouldn't be a problem with resistors in this range.

## Ladder DAC theory

Just to read if you are interested.

The ladder DAC is actually a quite simple thing to understand if you put some effort in it. So how it provides you the analog signal from the digital inputs? It simply boils down to the most fundamental law of electronics: The Ohm's law, you know, the relation of current, voltage and resistance: current (I) = voltage (U) / resistance (R). You can use this law on any (well, mostly DC as with AC things start to show much more peculiar behaviors) circuit as long as they are unfold-able to simple serial or parallel constructs. The ladder DAC, at least without considering the load on it's output, is such a circuit. See the image below.



- Title: [Ladder DAC](#)
- Created: 9th Mar 2012
- [Comments \(0\)](#)
- Tags:
- Ladder DAC theory: Just use Ohm's law, and you are done understanding how a ladder DAC works.

### [Ladder DAC simple examples](#)

This small image shows the case of a theoretical 1 bit and a 2 bit DAC with all data pins set. A ladder DAC's highest voltage output is so one "step" lower than it's digital source's voltage. If all data pins are disconnected, obviously the output will go down to ground (0 volts). In the 2 bit DAC example you might try switching only D0 or D1 to ground, you will see that in the first case you get 2,5 volts, the second, 1,25 volts. D1 is so the more significant output pin.

With this you may well see that adding more steps to the ladder will behave similarly, each step doubling the set of possible output voltages. So that's how it works.

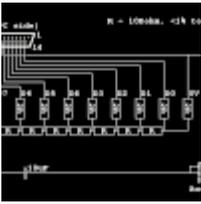
### Some final words

After several years my little pile of resistors still functions properly, well, what can go wrong with such a simple thing? It is an easy and I think rewarding project for anyone who likes these retro stuff and wants to take a peek in electronics. Just do it if you like, nothing can go wrong if you are careful (Maybe if you are afraid of it, try the DAC on some less valuable PC than your loved vintage laptop to avoid damaging it's LPT port by some accidental short in your circuit).

### Bad circuits around

Note that there are several sites showing various forms of the DAC including this plain form and externally powered ones with an integrated amplifier. I observed that on many sites the simple DAC (Without an amp) is incorrectly shown with an 'R' valued resistor across the sampling points (The terminals of the audio connector). This won't work. If you soldered one together that way, just rip that 'R' out from there, it will likely produce some more meaningful sound then :)

### Referred artworks



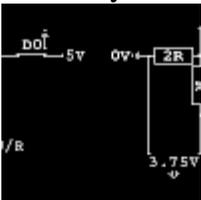
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## External links

- [Impulse Tracker](#) Module tracker for DOS supporting many cards, even PC Speaker
- [Interfacing the LPT port](#) Some nice explanations & stuff over parallel
- [SAC sound-related](#) Old DOS sound & music programs including stuff for LPT DAC
- [Virtual Sound Blaster](#) DOS software emulating the DSP of the SB over LPT DAC

## Comments

No comments so far. Be the first to comment!

## Make a comment

### Rules

1. Please be polite (Leave all your trolls in their respective caves).
2. If #1 fails, don't feed 'em. They bite.
3. No links allowed. It won't pass. Neither chains. Use '(dot)' notation.
4. Spam reeks.
5. Text is (some day will be) formatted with [Markdown](#).
6. Your mail address is only visible to me: I understand you also don't like #4.
7. The mail address you provide is also used to fetch your [Gravatar](#).
8. Danger! High voltage! Right between your "Post Comment" button and ground.
9. Still want to comment? Go ahead! :)

Name:

Email:

Comment:

## Recommended:



- Title: [Using non-square pixel aspect ratios in Gimp](#)
- Created: 16th Nov 2015
- [Comments \(0\)](#)
- Tags: [retro](#), [commodore 64](#), [pixel art](#)
- In this article I am going to cover how it is possible and probably the most efficient to work with images using non-square pixels in Gimp. Why this has some importance? It is mainly useful for doing artwork for retro computing such as the quasi-standard 320x200 256 color VGA mode, the Commodore 64 and several other machines and display modes of the 80s which frequently had non-square pixels.



- Title: [Spinosaurus Aegyptiacus 2015](#)

Created: 8th Jul 2016

- [Comments \(0\)](#)
- Tags: [digital art](#)
- Spinosaurus Aegyptiacus reconstruction (at least an attempt at it), as of 2015 knowledge: the Ibrahim et al. papers from 2014 and the later adjustments on the hindlimb size, discarding the quadrupedal stance. Fleshed out according to some own ideas as well as various existing knowledge on the animal.



- Title: [Northern Hungary, 2015](#)
- Created: 23rd Aug 2015
- [Comments \(0\)](#)
- Tags: [nature](#), [photograph](#), [olympus c2500l](#)
- In July, 2015 we made a trip to Northern Hungary with a friend, namely the hills of Aggtelek. I dusted off my old Olympus C2500 camera for it, a little miracle by itself: it survived, and the photos turned out to be quite worthwhile! Apart from the famous caves, there are no serious mentions in this region, however beauty not always comes advertised!



- Title: [Brass wyvern](#)
- Created: 12th May 2015
- [Comments \(0\)](#)
- Tags: [wyvern](#), [dragon](#), [digital art](#)
- What happens when something gets me really inspired in the process... (Click the image to get it in 1920x1200) You could also check out the related article for the backgrounds and some research over airworthiness. Enjoy!



- Title: [Stormcloud panorama #2](#)
- Created: 1st Jun 2016
- [Comments \(0\)](#)
- Tags: [photograph](#), [nature](#), [olympus c2500l](#)
- Panorama of a passing stormcloud south of Budaörs (Hungary) in the sunset, the first day of summer, around 20:15.



- Title: [Sand Lizard peek](#)
- Created: 19th May 2012
- [Comments \(0\)](#)
- Tags: [lizard](#), [photograph](#), [olympus c2500l](#), [nature](#)

- A Sand Lizard peeking through the bushes. Took with an Olympus C2500L, an 1999 digital camera. It could have been better if the tip of his nose was visible, but one can't get a lizard posing for him!



- Title: [Remembering a Lost World](#)
- Created: 12th May 2010
- [Comments \(0\)](#)
- Tags: [cheetaan universe](#), [city](#), [cheetah](#), [nir](#), [digital art](#)
- This large digital image was drawn for more than two months until it was completed (Or better to say I thought there is no much to do with it any more). It is one of my better pieces although it suffers some coloring problems. The theme would be an abandoned city on Earth, with cheetaans wandering around seeking for the sunshine. This is a part of the "original" cheetaan story, that is the story of the first interstellar war between human and cheetaan.



- Title: [Malfunctioning lizard](#)
- Created: 3rd Sep 2016
- [Comments \(0\)](#)
- Tags: [lizard](#), [photograph](#), [olympus c2500l](#)
- Duh. This lizard was malfunctioning. It didn't run away :p



- Title: [Flying over the cheetaan homeworld](#)
- Created: 14th May 2016
- [Comments \(0\)](#)
- Tags: [cheetaan universe](#), [dragon](#), [wyvern](#), [digital art](#)
- Probably one of the most condensed scenery possible on the cheetaan homeworld before the wars. A huge gas-giant, exomoons, a gargantuan creature resembling a tiger, a cheetah riding a feathered wyvern over crystalline buildings scattered in a swamp, anything missing?



- Title: [Siemens-Nixdorf PCD-4ND](#)
- Created: 22nd May 2011
- [Comments \(4\)](#)
- Tags: [siemens nixdorf](#), [retro](#)
- The Siemens Nixdorf PCD-4ND is a rather common piece of old laptop, and actually it is a very decent one! In short it is a very nice piece of equipment for daily use with a not too fast but still decent color LCD display driven by the good old Cirrus VGA chip (512Kb VRAM), a 4.86 processor at 50-100 MHz, and

native Sound Blaster compatible sound solution in certain models. These features can make it ideal for running most of the games and software from the old DOS era.



- - Title: [Towers of Ice](#)
  - Created: 5th Jan 2011
  - [Comments \(0\)](#)
  - Tags: [photograph](#), [olympus c2500l](#), [cave](#), [winter](#)
  - Ice formations in the cave "Kőlyuk" in the Bükk mountains, Hungary. Usually winters are not too cold in Hungary, rarely getting temperatures below zero in the afternoons. Sometimes however for short periods extreme colds may settle in here for a few weeks which may be ideal for getting such ice formations in these water-rich limestone mountains.



- - Title: [Summer starts with a beautiful passing storm](#)
  - Created: 1st Jun 2016
  - [Comments \(0\)](#)
  - Tags: [nature](#), [photograph](#), [olympus c2500l](#)
  - The summer started with a beautiful passing storm at sunset at my location, a rare and amazing sight. As I realized what was going on, I rushed out quickly grabbing my old Olympus C2500L camera to witness and photograph this phenomenon...



- - Title: [Feathered dragon refsheet #2](#)
  - Created: 14th Aug 2015
  - [Comments \(0\)](#)
  - Tags: [dragon](#), [wyvern](#)
  - Continuing the design of a four limbed dragon. Here I used first-angle projection to shape the head, then added the whole body to the front view. This dragon is roughly similar by anatomy to the Tani Akri (the dragon from the Cheetaan Universe). There are some oddities of the design, making this creature "functional".



- - Title: [Tani Akri \(dragon\) reference 2017](#)
  - Created: 10th Jan 2017
  - [Comments \(0\)](#)
  - Tags: [cheetaan universe](#), [dragon](#), [wyvern](#)
  - A nice big reference for the Tani Akri, the dragon of the Cheetaan showing off some anatomical features. At last something which could probably really fly with wyvern as base.



- Title: [Over the Slums](#)
- Created: 2nd Aug 2007
- [Comments \(0\)](#)
- Tags: [dragon](#), [pencil art](#), [city](#)
- Pencil sketch on some A/5 leaf. Well, this is really on "some" A/5 leaf, although this is not as bad as some other such old pieces of mine. This was just on some thin paper with a triangle grid on it's back which would show through no matter what arcane thing you do with your scanner.



- Title: [Flight of a Dragon's demo released!](#)
- Created: 19th Dec 2016
- [Comments \(0\)](#)
- Tags: [dragon](#), [retro](#), [pixel art](#), [game](#), [programming](#)
- Flight of a Dragon is a retro game for the Uzebox open source game console, a bit of 8 bit madness involving an ATmega 644 and a bit of electronics to get it producing a video signal and accepting input from an SNES controller. Thanks to emulation, you may also try it out within your browser!



- Title: [Cheetaan City](#)
- Created: 29th Jan 2013
- [Comments \(0\)](#)
- Tags: [cheetah](#), [cheetaan universe](#), [nir](#), [digital art](#)
- Cheetaan city scene. Experimenting with foliage, and at last, some proper colouring. The Cheetaan (Tani), first time portrayed in a typical city setting of theirs. In the distance, the organic statue of the centre, a white arch of plant-sustained Mag-Lev track, with of course a lot of green, and the two Tani races who are primary builders of this civilization.



- Title: [Gold wyvern design](#)
- Created: 29th Jul 2016
- [Comments \(0\)](#)
- Tags: [dragon](#), [wyvern](#), [digital art](#)
- Yet another wyvern design aiming for realistic capability of flight and a dragonlike appearance, a controversial beauty. She has no direct relation to the gold wyverns of Outbreak to the Sky, although those were one inspiration source to design her.



- - Title: [A frozen wall](#)
  - Created: 5th Jan 2011
  - [Comments \(0\)](#)
  - Tags: [photograph](#), [olympus c2500l](#), [cave](#), [winter](#)
  - Ice formations in the cave "Kecskelyuk" in the Bükk mountains, Hungary, near the city of Miskolc. Usually winters are not too cold in Hungary, rarely getting temperatures below zero in the afternoons. Sometimes however for short periods extreme colds may settle in here for a few weeks which may be ideal for getting such ice formations in these water-rich limestone mountains.



- - Title: [Summer on the tracks](#)
  - Created: 5th Sep 2014
  - [Comments \(0\)](#)
  - Tags: [train](#), [nature](#), [photograph](#), [olympus c2500l](#)
  - In the summer, as in the previous years, I visited two narrow gauge railways for some voluntary work. One is the industrial railway of Szegvár of which I already have an older article here, the other which I started visiting in last summer is Kemence in Börzsöny. Thanks to the frequent rains the country was very nice this year, even though it gave us quite a mess to clean up at Szegvár.
- Created by Jubatian ([Contact](#))
- Powered by [ProcessWire](#)