

HI-FI and DSP based pedagogic project with PurePath

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Quick overview of French pedagogy in the learning of sciences and technologies.

In the French public education, during the two last years of secondary school, students who specialize in electronics and computing learn competencies and knowledge using inductive and deductive approaches, in technical systems issued from the industry. The pedagogy make use of objectives to reach and evaluate those competencies made of capacities and knowledge.

To do this, they use functional approach, to know the functional structure of the system and its interactions with its environment.

By this way, each schematic, program and mechanical structure that they study is linked with the others and with its role in the global system. Furthermore, in each system studied, they always have to optimize and improve some part.

These systems are always issued from industry, what means that manufacturers who agree to participate gives us all needed documentations, schematics, programs and others stuffs they have, when they approve that one of their systems became a subject of study for the public educational system (in France, nearly all the education is governmental, and all good schools from nursery to doctors are public). **By this way, industry and the learning of sciences and technologies are very tied.**

At the end of the first of these two years, we always give a space for a **domestic study**, in which students can plan and conceive a big part of the system, which generally try to integrate the more new and daily used technologies it can. By this way, we can **captive the students** and give them opportunity to work in something that they can get with them and which they can personalize and follow studying **according to their tastes**. This system tries to integrate the most of the academic knowledge of physic, electronic, and programming they have to learn.

Present project making use of classD, DSP and PurePath from Texas Instruments.

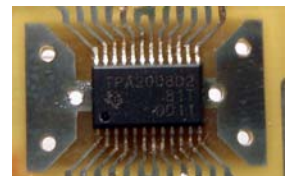
The project which interests us is based in a domestic device to listen music from whatever source (mp3 player, phone, CD player, etc...). The benefit of such a project is to familiarize young people to the real High Fidelity world, by learning all they want relative to sound physics. But there are a lot of scientific, technical and pedagogic advantages too ! These are what we seek to teach them in a more pleasant way.

This system give us the means to :

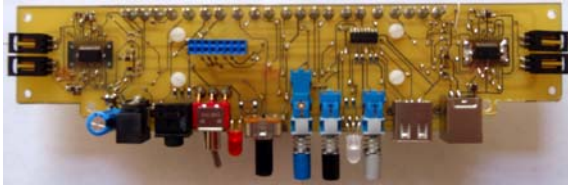
- link physic, mathematic, electronic and programming subjects, this aspect is essential to give interest to all teachings,
- study
 - ✓ analog and digital electronics, and conversions in both ways,
 - ✓ analog and digital filters, with all mathematical, physical and electronic aspects,
 - ✓ digital signal processing,
 - ✓ programming in assembler and C, and use of conceptual graphic tools,
 - ✓ use of microcontrollers,
 - ✓ I2C and USB buses,
 - ✓ lots and lots of more stuffs.

Our project is made of two parts :

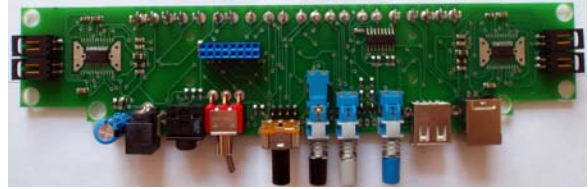
- The first one is just a device to reproduce sound and musique at HI-FI standards. To reach this, we conceived a system which use TI parts : two class D tpa2008d2 to get in stereo four 3W loudspeakers. The loudspeakers used have a nearly perfect amplitude curve from 100Hz to 20kHz, and below 100Hz can be corrected by filter. Other elements are optimized too : excellent switching supply and decoupling, optimized design, and so on...



But this base have an expansion connector, which can be switched active by a push button, to become inserted between the music source, and the class D amplifiers. This connector is linked to USB A and USB B ports, to have the possibility to read USB source, and become an USB device driven by a computer, like the TAS3204EVM. Two push buttons, two led and a I2C expansion connector for a screen are available to give the product full expansion capacity. Then this connector allows an expansion card to process sound and make use of those USB ports, and interact with user with buttons, leds and screen !

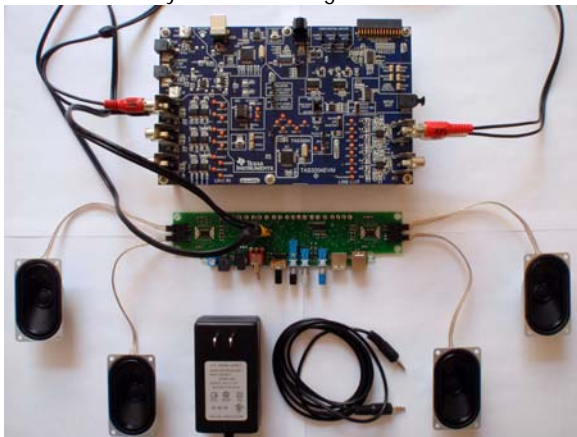


First prototype, fully functional

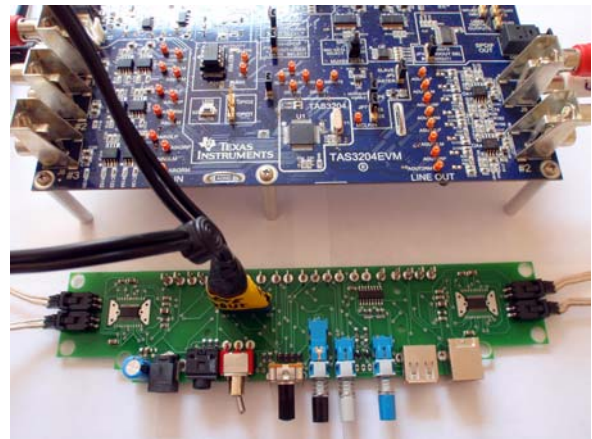


Professional PCB, but all soldering job and adjustments hand made !

- Then the second part is an expansion card that can be analog or digital. In the analog case, it gives students the possibility to make their own very cheap designs, and help physics teachers to start with filters. In the digital case, using DSP, they can simulate analog filters, but more than that, they can program every kind of IIR or FIR filter, and even more : whatever effect they want ! In our case, we will use the TAS3204 DSP from TI, to get a full PurePath system (with tpa2008d2 parts). It will be able to manage powerful effects, and other functions from its microcontroller. Furthermore, coupled with a TUSB3210PM, and the appropriate program, it gets USB connectivity and can be controlled by PurePath Studio, like the TAS3204EVM, and become in the same time :
 - ✓ a very powerful lab's device to teach all the stuff quoted before,
 - ✓ a pleasant and useful device for student to get with them,
 - ✓ a fantastic base for them to follow designing cards and programs at home for their pleasure or to give application to what they will learn during their academic course !



TAS3204EVM connected to the expansion port...



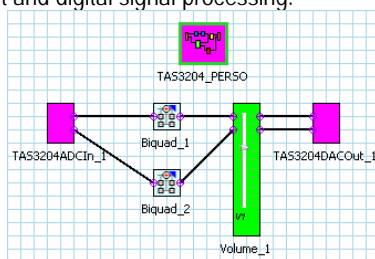
Perspectives.

We already conceived, and fabricated the first part, so that each student have its own one. We connected TAS3204EVM to the expansion connector to learn to use it, and to listen in real time the effects created with PurePath Studio.

Now we are designing an expansion card which will :

- make use of USB B to connect it to PC and use it with PurePath,
- make use of push buttons and leds, and eventually I2C screen to make it interactive with user, when effect designed with PurePath are saved to the EEPROM coupled with the TAS3204,
- give students opportunity to make a lots of captures and measures with all the test points of amplifiers card and expansion card,
- give them the possibility to work and program it at home.

Thanks to the USB to I2C adapter with program sources from TI staff, and the PurePath Studio tools to design filters and effect, and with the use of external tools too, like those of Matlab, students will be able to learn all the stuff quoted in this document and much more, do it at school but at home too, and customize their system, and follow using it next years, specially if their want to study electronics, program development and digital signal processing.



PurePath Studio and Keil uVision

