SixPak Ultra for XT/AT bus (ISA)

ECE 1895 Final Project

# Description

The original IBM PC and PC/XT is an authentic open architecture (other than the BIOS) with a relatively simple bus retroactively labeled ISA (industry standard architecture) by Compaq. The simple design of the PC mainboard means the original XT has minimal onboard devices, and the users must add on their own UART, Display Adapters, Parallel Port, RTC, Hard Disk Drive controller, Floppy Controller, and so on. The 8 slots on my PC/XT have been completely filled with various adapters.

The one critical issue with my current XT setup is the lack of a potent graphics adapter. It currently has a CGA (Color Graphics Array) adapter built by Quadram corporation in 1983. For unknown reasons, they utilized completely orthogonal wiring for the adapter with the 16k graphics SRAM located quite far away from the bus. This could be the reason that although the SRAM has a fast enough access time (100 ns), the SRAM cannot be updated fast enough by the NEC V20 when my bus is running at 7.12Mhz (clock generated by the PC-SPRINT board). This generates a lot of garbage on the screen whenever the processor does any graphics-intensive tasks under turbo mode.

The inherent problems of CGA – 8x8 text mode character, only 80x25 text mode, non-square pixels, and ugly color palettes during graphics mode are also limiting the capabilities of the machine significantly. So, in this new project, **the core capability of the SixPak Ultra is a VGA adapter built upon the famous Trident TVGA9000i VGA controller for the 8-bit XT bus architecture.**

But it would be a great waste of a slot if the only capability of the card is a graphics adapter. ISA being a true no-BS system bus (like Woz’s apple II bus), we can attach 20000 devices to it without it giving any complaints. The only limitation is the interrupt/DMA and memory address space of the host system, which can be fixed through a few DIP switches connected to the bus mux and minimal glue logic.

So, the additional 5 functions added to this card will be

1. **an updated Intel 16550 (from the old 8250) UART**, which now sports a FIFO buffer and support for high speed (115200+) baud rate.
2. **an Ethernet adapter** based on the Realtek RTL8019 controller.
3. **an Adlib-compatible sound card** based on the famous Yamaha YM3012 OPL2 chip
4. **a PC8477BV-based high-density floppy controller** for diskette operations higher than that old 360k DSDD drive.
5. **an RTC clock** based on the “explosive” DALLAS DS12885 clock chip

Yes, the name takes direct inspiration from the illustrious AST SixPak plus. But as AST has been gone for over 20 years now, I think we can at least recycle this famous trademark a little bit. The ample size of a full-height, full-length ISA card will give me a lot of room to fit all these logic on board. And my previous experiences with ISA (555-project 1), Analog-Digital mixed PCB design (VDM-22) will come in handy in this case.