Texas Instruments Electronics Online Challenge 2021

Dell Optiplex 780 PC

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Project Report

After the power supply stopped working in an old Dell Optiplex 780 PC, it became useless, and our team decided to use this device for our *Electronics Online Challenge.* The Dell Optiplex 780, first released to the world in 2010, was a strong performer in its class. We chose a PC because the components are similar to anything that processes information, from VEX sensors to the VEX brain.

To access the main components on the motherboard, we had to remove the large components in the PC tower. After taking the backside off of the tower, we carefully removed the DVD player, the power supply, multiple fans, and wiring to reveal the motherboard. In order to take the motherboard off, we had to unscrew nine (9) Phillips head screws to remove the motherboard from the tower. After removing the motherboard, we identified most of the different components of the motherboard. These included resistors, capacitors, chips, and more. Most of them were labeled with a code, and some of them also included a manufacturer, like Intel, SMSC, ST, and Macronix. Most chips were easily identifiable by their chip codes, and, through a simple google search, our team was able to access the datasheets for each chip. Although there are plenty of chips on this motherboard, many of them were very simple and appeared multiple times.

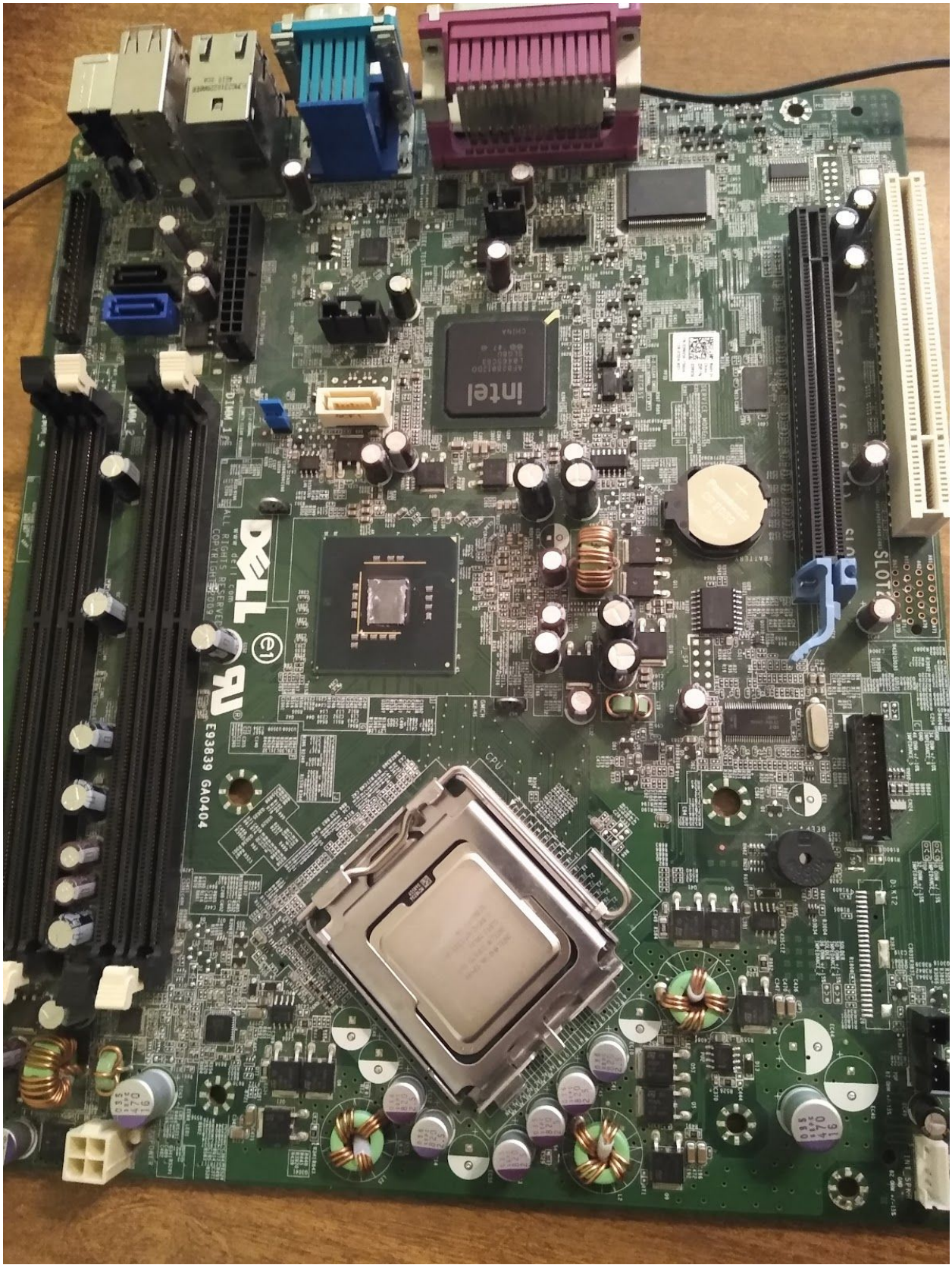
While we knew that motherboards are very complex, it was interesting to see an older one because there are much more components such as inductors and capacitors than a newer motherboard. We expected to see more variety of integrated circuits on the motherboard, but other than the 3 main intel chips, the remaining integrated circuits are mostly just drivers for various inputs and outputs. Another surprise was the number of individual mosfets and transistors on the board (over 50!). It was also surprising that there was such a large variety of

brands of chips on the board, and it was very educational to see the varying datasheets for these chips.

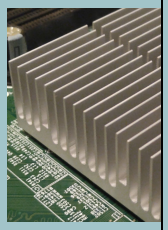
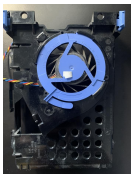
After analyzing and researching all of the chips we could find information for on the motherboard, our team learned a lot from taking apart an old PC. By researching all of the chips and components, we could see what each chip does, and how the PC as a whole performs with it. Since this was a relatively old PC, we realized the vast improvement of chips over just one decade. This computer, which was one of the most advanced computers during its release year, contained obsolete chips that are not even relevant today. We also learned that a PC has many, many components. This specific one contained over 300 parts! It was interesting to learn about the older parts of a PC. Finally, the team learned a lot about the classification of components, the usage of datasheets, and the researching process.

Report word count: 474

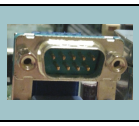
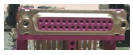
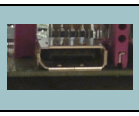
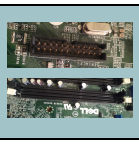
Figure 1.1 A picture of the whole motherboard to show the layout of the components.



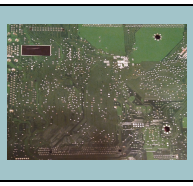
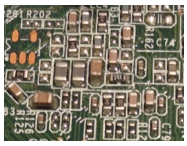
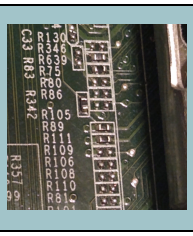
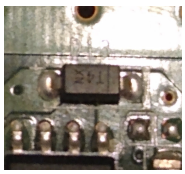
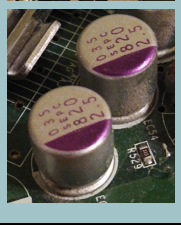
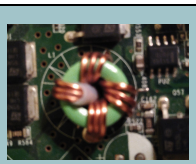
General Components Table

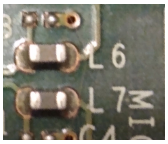
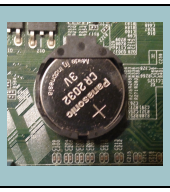
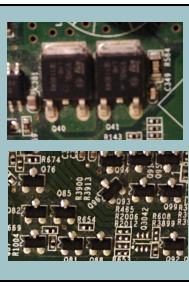
Figure	Picture	Component	Quantity	Function
2.1		Heatsink	2	Has a large surface area to allow heat to be distributed to prevent the chips from overheating.
2.2		Power Supply	1	Converts AC power to low-voltage DC for the computer components to use.
2.3		Case	1	Serves as a place to contain and mount all internal components.
2.4	 	Fans	2	Draws cooler air from outside the case to cool the internal components down, and to prevent the components from overheating.
2.5		DVD player	1	Allows users to insert a DVD for the PC to read to play.

Ports Table

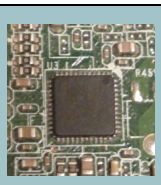
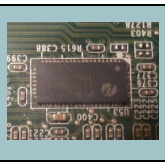
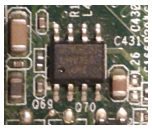
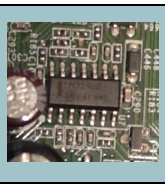
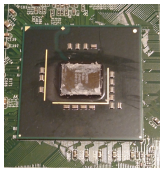
Figure	Picture	Port	Quantity	Function
3.1		USB	8	USB or universal serial bus is used to connect to other devices like digital cameras, printers, scanners, hard drives, etc.
3.2		DB15 or VGA	1	Video output to hook up an external display.
3.3		DB9	1	Most commonly used for asynchronous communication using the RS-232 system.
3.4		DB25	1	Used for similar purposes to the DB9 but it has more pins available for quicker communication.
3.5		Display port	1	A now obsolete alternative to the vga port.
3.6		Audio port	4	Two are audio input for a microphone and two are audio output for a speaker.
3.7		Ethernet	1	Ethernet is used to connect a device physically to the local network.
3.8		Esata port	1	Used to connect to an external harddrive.
3.9		Headers	15	Used to connect the computer to fans, serial connections for debugging, memory expansion,etc.

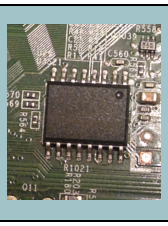
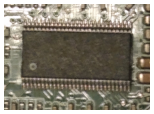
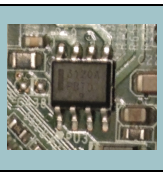
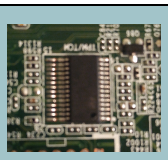
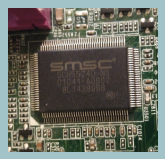
General Electronics Table

Figure	Picture	Component	Quantity	Function
4.1		Circuit Board	2	Insulated board with conductive traces to connect electrical components together
4.2		Surface Mount Capacitors	100+	Used for timing circuits, reducing ripples, coupling, and decoupling when only a small amount of capacitance is needed.
4.3		Surface Mount Resistors	100+	Used to reduce current, adjust signal levels, divide voltages, terminate transmission lines, etc.
4.4		Surface Mount Diodes	10+	Only allows current to flow in one direction.
4.5	 	Electrolytic Capacitors	42	Used for capacitor functions listed in figure 4.2 when larger capacitance values are needed.
4.6		Crystal Oscillator	1	Provides a clock for microprocessor timings.
4.7		Toroid Inductors	5	Stores energy in a magnetic field which resists a change in current flow.

4.8		Surface mount inductors	25+	The same purpose as figure 4.7 but used at higher frequencies with a lower inductance value.
4.9		Coin battery	1	Powers the memory which stores the bios settings and the computer's real time clock when the computer has no other power source.
4.10		Push-button	1	The power button which is mechanically connected to the button on the outside of the case.
4.11		Transistors	50+	The transistors vary greatly in size with some being MOSFETs (metal-oxide-semiconductor field-effect transistor), some being PNP, and some being NPN transistors. They are used for amplification, switching between signals at high speeds and simple logic circuits.
4.12		Surface mount led	1	Turns electrical energy into light energy which indicated that the computer is powered on.

Integrated Circuits Table

Figure	Picture	Component	Quantity	Function	Info Link
5.1		AD1984A	1	High Quality Audio Codec • Up to 192kHz sample rate • Simultaneous record for 2 channels • Simultaneous playback for 2 channels	Datasheet
5.2		WG82567LM	1	Ethernet Transceiver • Supports 10, 100 and 1000 Mbps.	Datasheet
5.3		TI GD75232	1	RS232 Driver and Receiver	Datasheet
5.4		Intel AF82801JDO	1	I/O Controller Hub • Audio interface • Bus interface • USB 3.0 ports • LAN controller • Media Interface • etc	Datasheet
5.5		PI4PCIE2612 - BZFE	1	6 channel 1 to 2 mux and demux for display port. • High-speed channels up to 5Gbps	Datasheet
5.6		PAECJ LMV358	1	Low voltage operational amplifier	Datasheet
5.7		LM324DG PAF945	1	Single supply quad operational amplifier	Datasheet
5.8		AC82Q45	1	Intel graphics and memory controller hub	Datasheet

5.9		MX25L644	1	8 kilobytes of flash memory ● 100,000 erase/program cycle ● 20 years data retention Most likely used to store the BIOS.	Datasheet
5.10		CV184-2APAG	1	Programmable flexpc clock ● CPU and SRC clock frequency programming with 1 Mhz stepping	Datasheet
5.11		3120A	3	Dual MOSFET driver with output disable	Datasheet
5.12		INTEL CORETM2 DUO	1	Dual-core processor ● Intel 64 architecture ● Supports dynamic execution ● Instruction, write-back data and second-level shared advanced transfer cache. ● Data prefetch logic ● Streaming SIMD Extensions ● Advanced power management ● Execute disable bit support	Datasheet
5.13	   	Unidentified IC	4	Despite looking up chip codes, looking through many websites, etc, we could not find any descriptions or datasheets for these chips.	None found

Works Cited

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