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Reverse Engineering: Computer Motherboard

TEAM 3204U
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Introduction

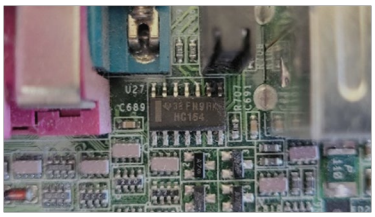
We are 3024U, VRC team from St Peter's College, Palmerston North, New Zealand. Ever since our founding in 2017, we have seen a number of team members come and go, with our current line-up consisting of 4 members: Jacob, Caelin, Jack, and Cullen.

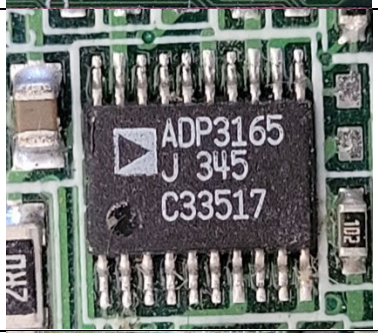
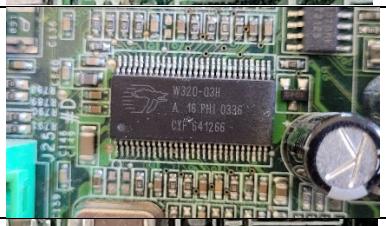
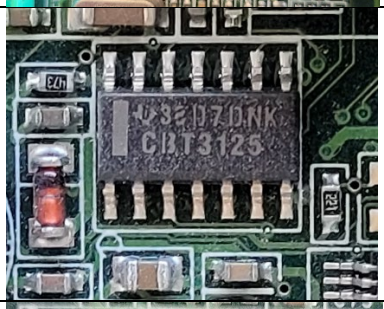
Our Device

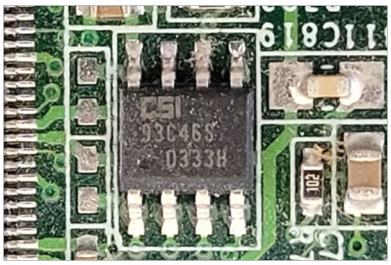
For the Reverse Engineering Online Challenge (sponsored by Texas Instruments), we decided to look at a PC motherboard. We did this for a few key reasons, including:

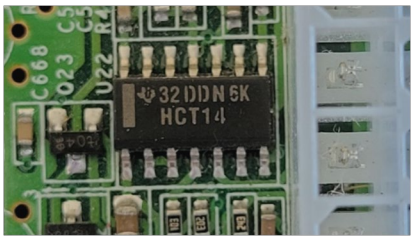
- The fact there is little to tear down, so we could focus our effort entirely on the PCB
- It is a very complex electronic device, so had a large number of components that we could look into.
- It was quite old, as it made in 2001, so finding the parts and specifications for each microchip was quite a challenge

Jacob happened to have an old PC at home that we could tear down, so we got started right away. Initially, we wanted to find and document every chip, resistor, capacitor, and diode on the board, but after seeing the sheer number of these, it was determined that this would be impossible in the timeframe available. As a substitute, we instead focused on all the chips with legible part numbers on the board. We have compiled our findings in a table, which is shown below.

Name Of Component	**Image Of Component**	**Description of Component**	**Purpose Of Component**
Texas Instruments CD74HC164		High Speed CMOS Logic 8-Bit Serial-In/Parallel-Out Shift Register	Appears to be connected to status LEDs, as there would not otherwise be enough internal IO to control them.

Analog Devices ADP3418		Dual Bootstrapped 12 V MOSFET Driver	Allows the BOIS to control the CPU power delivery MOSFETs
Texas Instruments SN75185		RS-232 Driver	Controls the serial port on the rear of the motherboard.
Analog Devices ADP3165		Multiphase PWM Controller	Appears to be a part of the CPU power delivery system
Cypress W320-03H		200-MHz Spread Spectrum Clock Synthesizer/Driver	Generates the clocks for all the components on the motherboard
SN74CBT3125		Quadruple FET Bus Switch	Appears to be connected to the north bridge
Broadcom BCM4401KQL		Ethernet Controller	Allows the computer to use networking through it's Ethernet port.

Catalyst Semiconductor 93C46		CMOS Serial EEPROM	Appears to contain the code required for the clock generator circuit to function
Intel 82801DB		Southbridge	Connects the IO to the host controller, which is then connected to the CPU. Some of the interfaces it controls include PCI (**Not PCIe**), USB, and the IDE interface for connecting a hard drive.
PMC-Sierra Pm49FL004		LPC Flash Memory	The purpose of this flash storage is to provide BIOS files that load the bootloader of the operating system.
SMSC LPC47M112-MC		BIOS	This chip is what the operating system interfaces with to control the IO. It is responsible for controlling the south bridge, as well as any additional IO not connected directly to the south bridge
Texas Instruments SN54LVC00A		4-ch, 2-Input, 2-V to 3.6-V NAND Gate	Probably checks to see if all the components are functioning correctly

Texas Instruments SN54HCT14		Schmitt-Trigger Inverter	Appears to “clean” an analogue signal, convert it to a digital signal, and then invert it.
Intel 845GV		Northbridge	Acts as an intermediatory layer between the CPU and the southbridge. In this case, it connects the CPU and RAM together, as well as controlling the graphics card interface, which on this particular motherboard is just a number of solder pads to which a slot could be soldered to at a later date.

Conclusion

Despite the age of these components, we were eventually successful at finding the uses and functions of each part. However, that doesn’t mean that it was easy. Along the way, we learnt a number of important lessons, which include:

- How to recognise semiconductor manufacturers by their logo
- How to use a phone camera to view extremely small objects and text
- How to read highly distorted and scratched text
- How to find part numbers on the chips
- How to research the part numbers that we found

If we were to do it again, there are a few additional things we would do differently:

- Using a more modern device
- Using either a magnifying glass or a microscope to get a better view of the text on the chips
- Attempt to reverse-engineer the PCB and create a fully functioning copy of it

Thanks, team 3204U