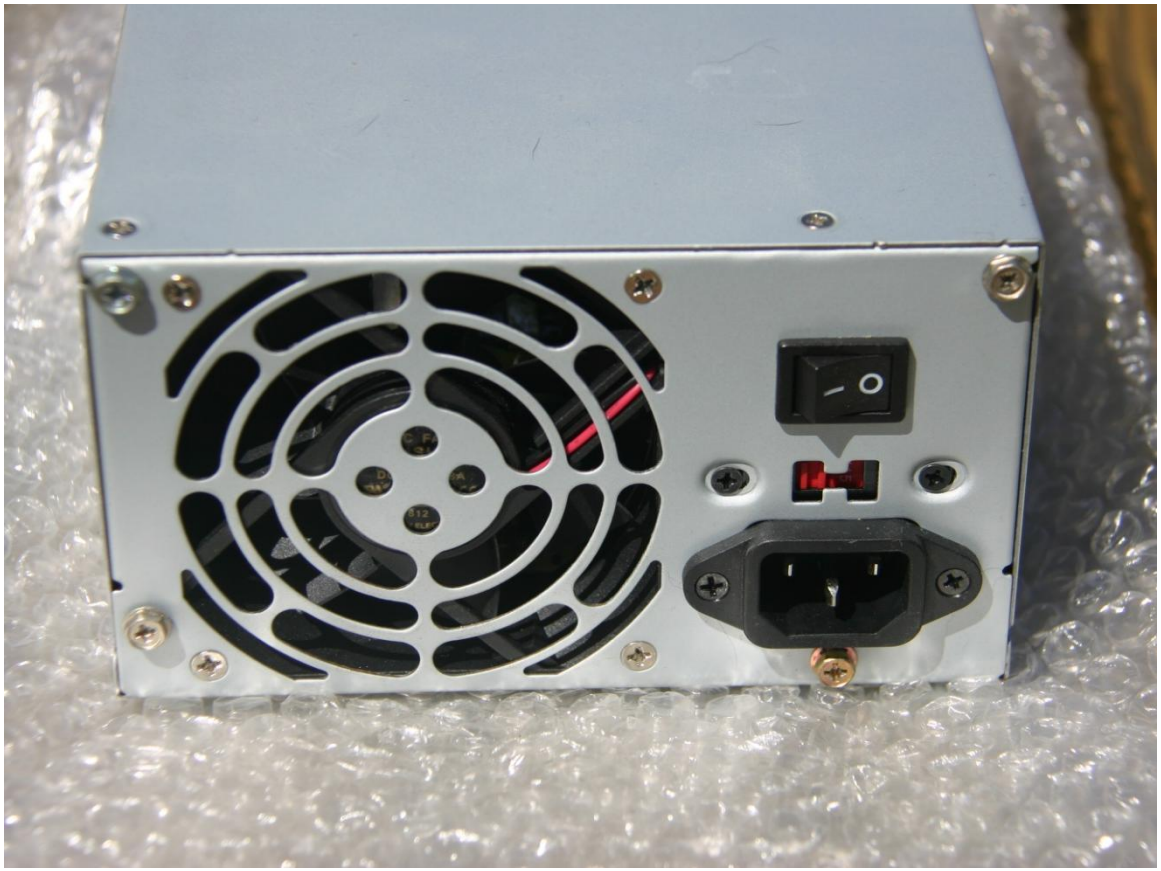
Hardware

Omni-Tech H3222 Computer (2003)

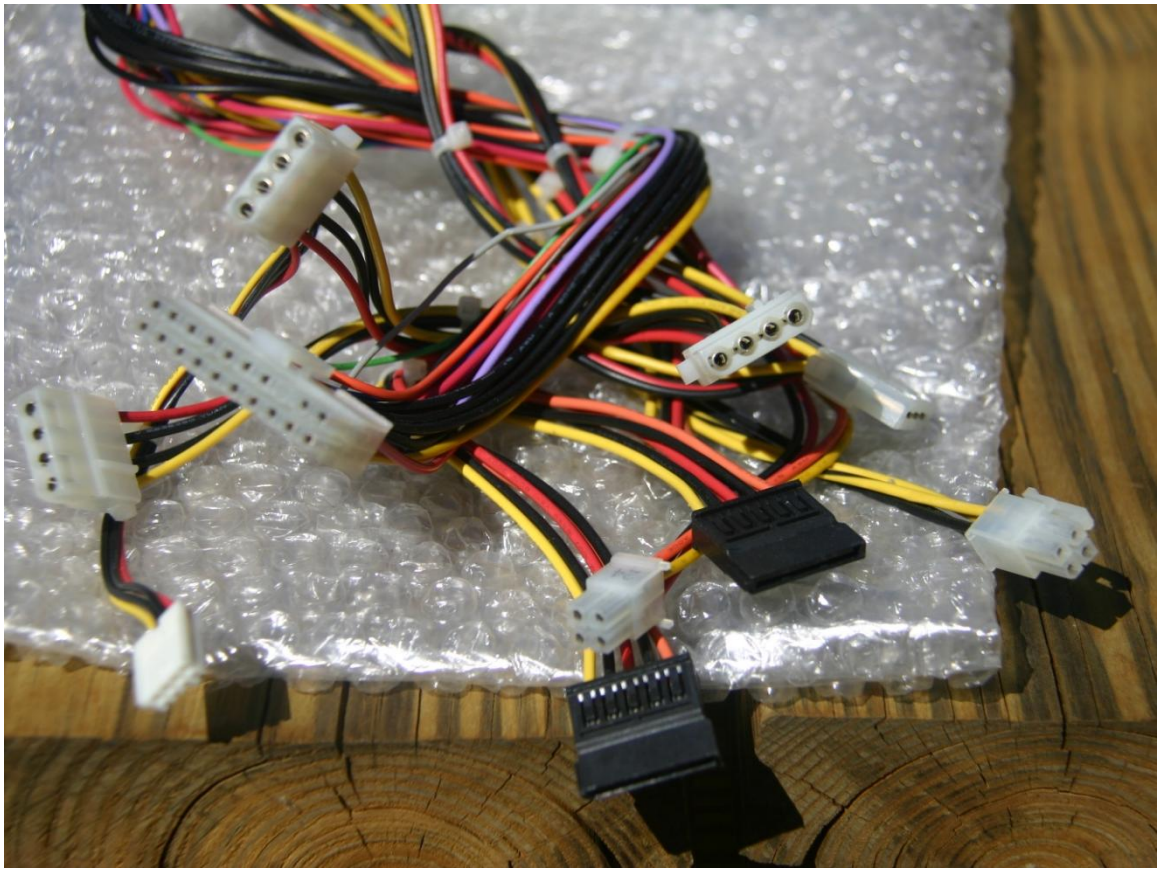
Omni-Tech H3222 Computer (2003)

side panel removed



Power Supply

Power Supply Connectors



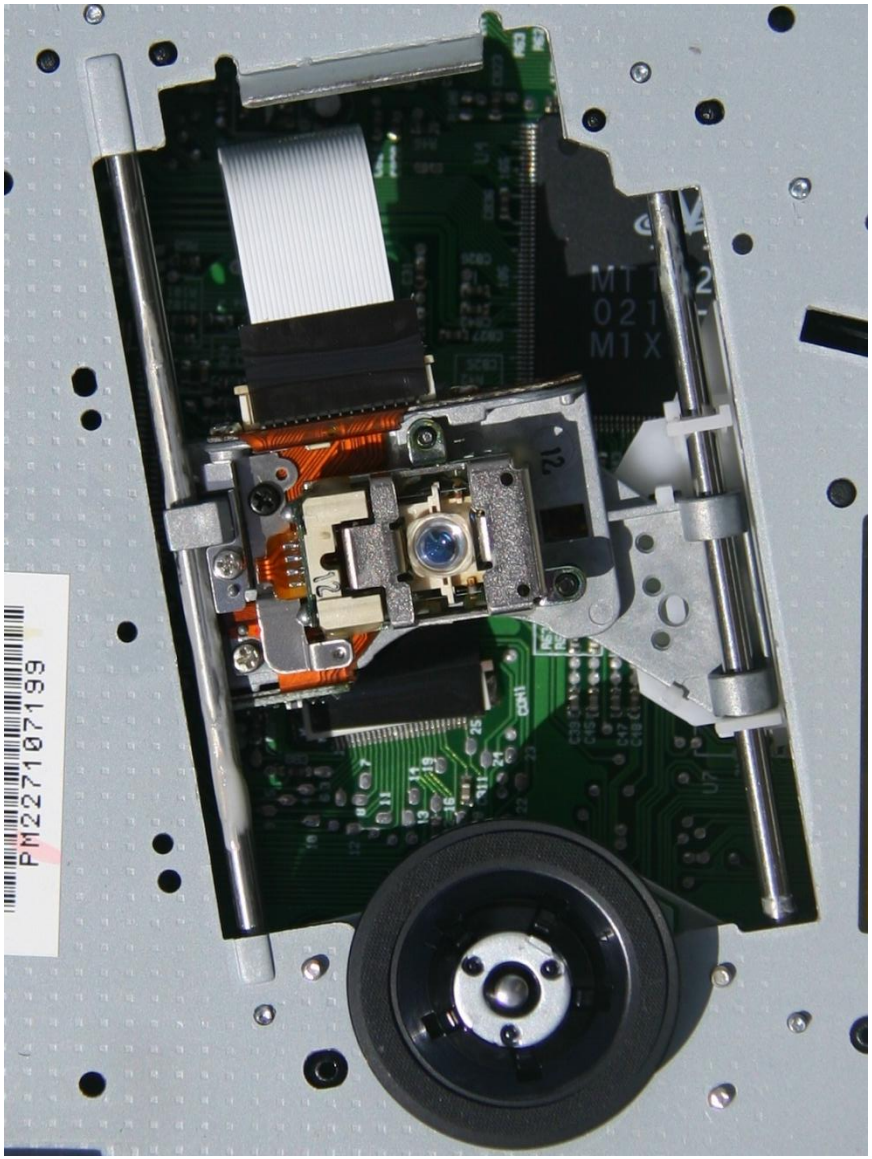
If the plug fits, then it’s safe to use and will work.

Optical Drive

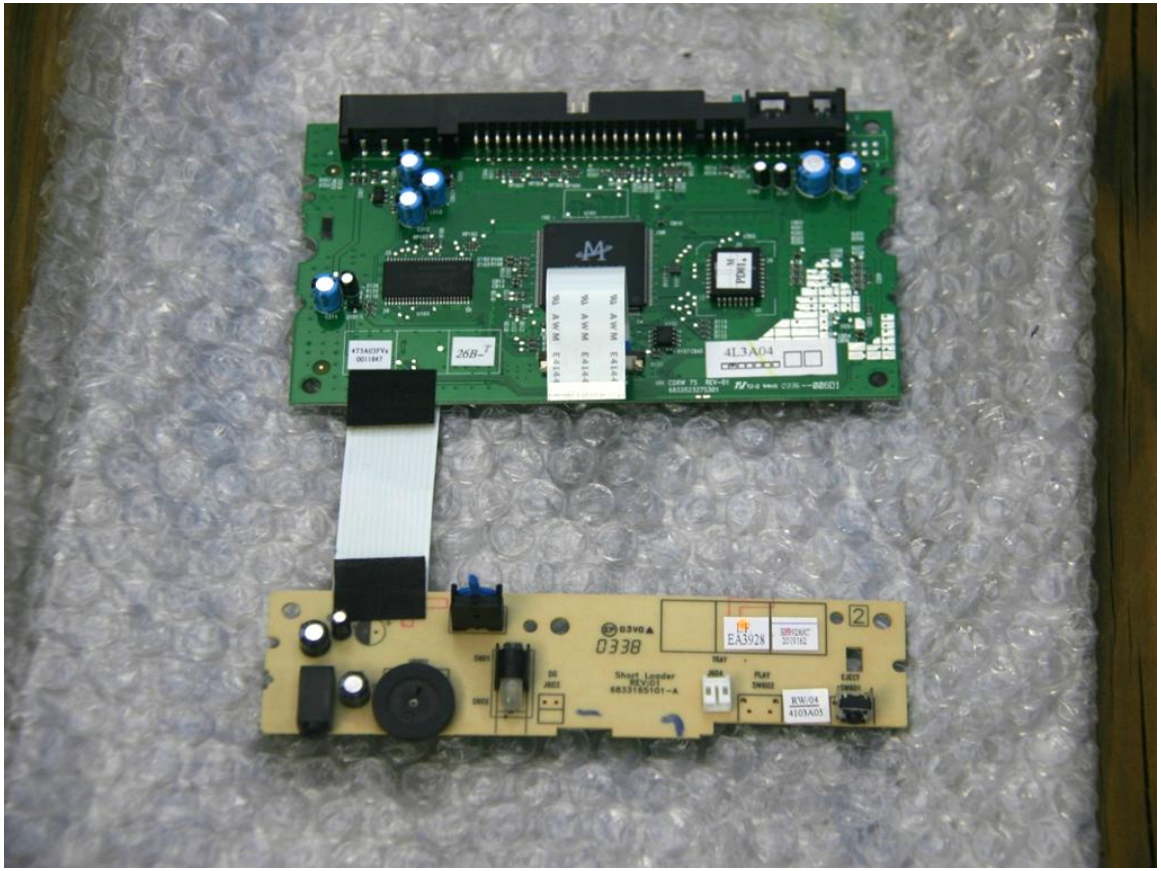
BluRay, DVD, and CD drives are all backward compatible for disks –
BluRay drives can read BluRay, DVD and CD disks.
DVD drives can read DVD and CD disks.

Optical drive partially disassembled

Optical drive, disassembled with tray out

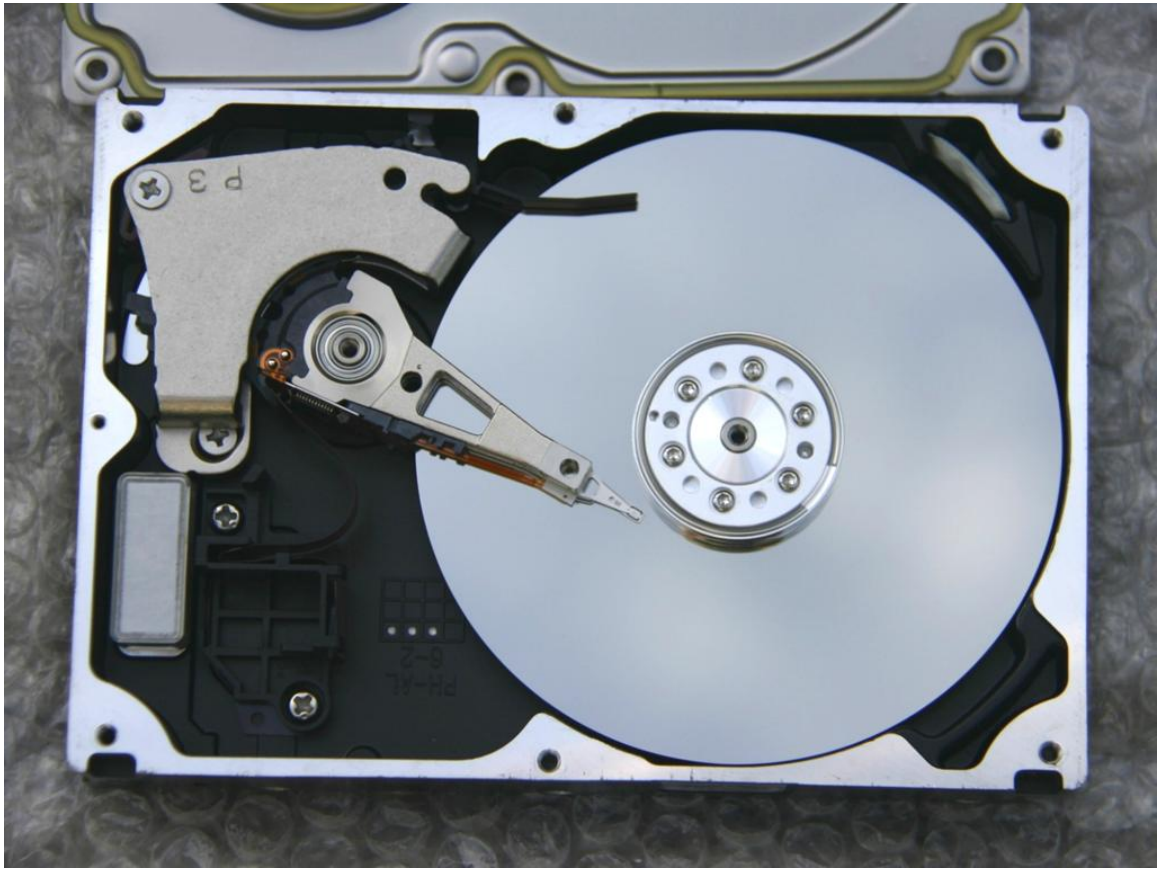


Optical Drive Laser Pickup Carriage



Optical Drive Controller

Internal Hard Drive



Hard Drive disassembled

Showing the rotating disk, and the moving Read / Write Head.

Hard Disk Drive Controller

All four disk drives

including the now obsolete floppy drive and Zip Drive

Disk Drive Connectors

Notice that the bottom three are all the same – they are completely compatible.

Isolation of complexity – to the rest of the computer, all three are exactly the same.

The Controller circuit boards on the bottom of each drive handle the differences.

The engineers will keep newer drives compatible with older drives if they possibly can, both technically and economically.

Solid State Drive

Completely compatible with Hard Disk Drives and Optical Drives,
but made with solid state flash memory.

Faster, more dependable, less power consumption,

but more expensive than hard drives.

Only memory used in modern thin notebooks, all tablets, and cell phones.

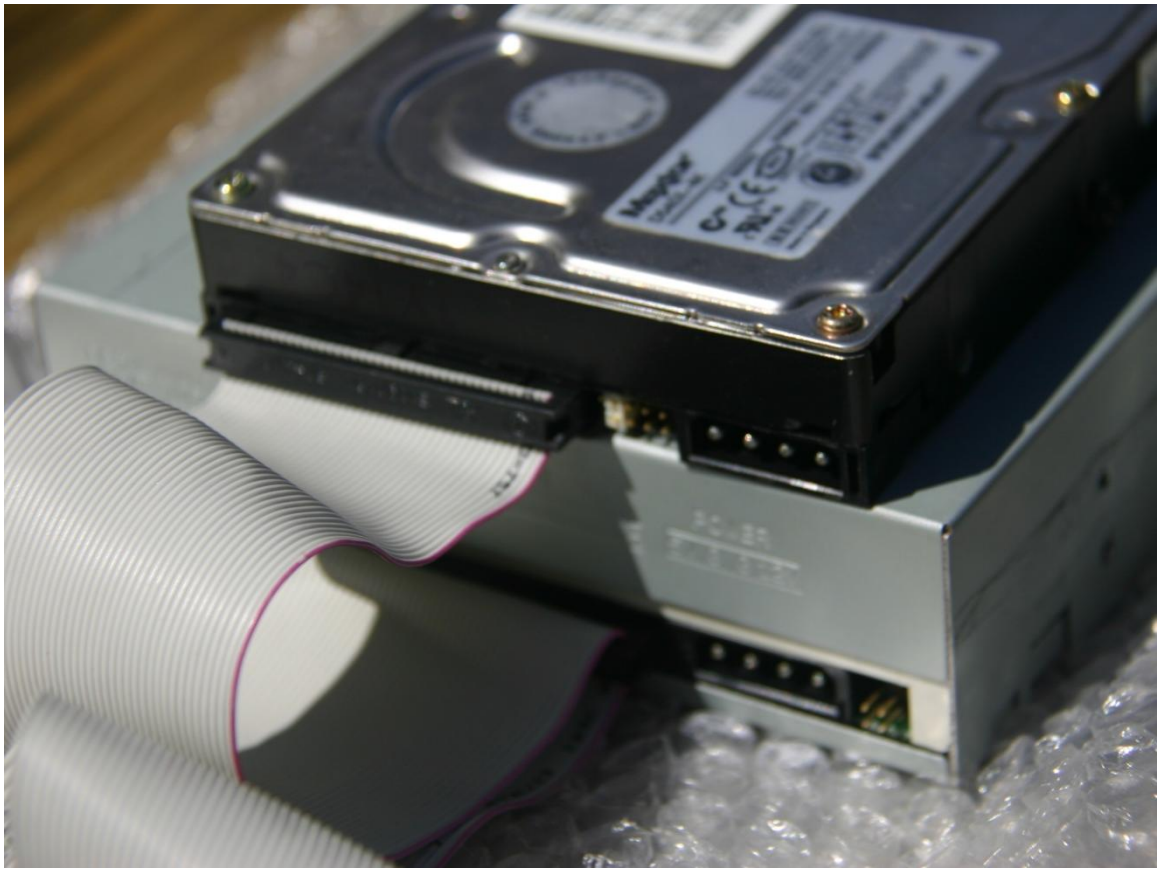
Solid State Drive

Interior of older SSD drives with compatible connectors to Hard Disk Drives.
Desktop and notebook versions,
essentially the same except for packaging and connections.

Thumb Drives use a completely different connection

However, from a user's perspective, all drives are same.

Isolation of complexity, this time not with hardware compatibility, but with software (the Windows or Mac OS operating system).



Ribbon Cable

Connected to the Hard Drive and Optical Drive

If the connector fits, then most of the time the equipment will work.

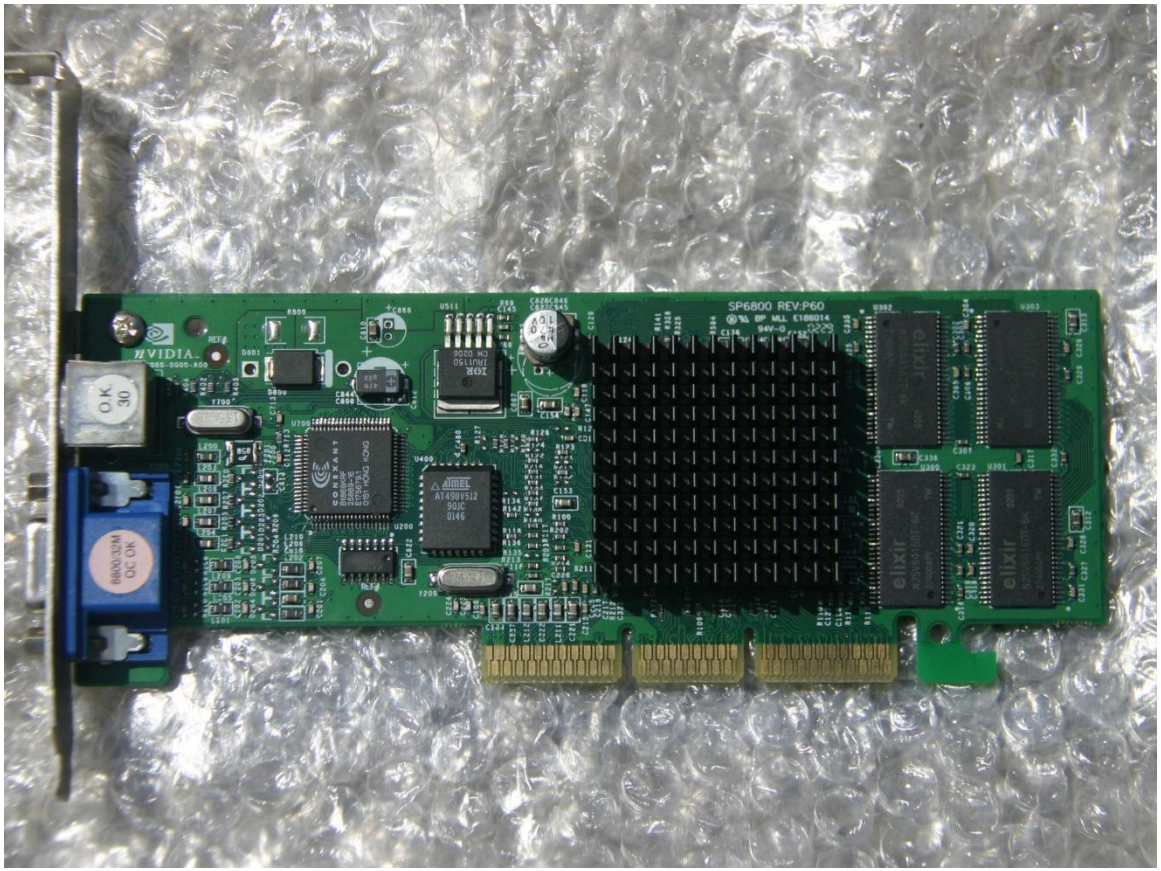
Ribbon Cable

showing motherboard connector

Motherboard

with all removable components attached

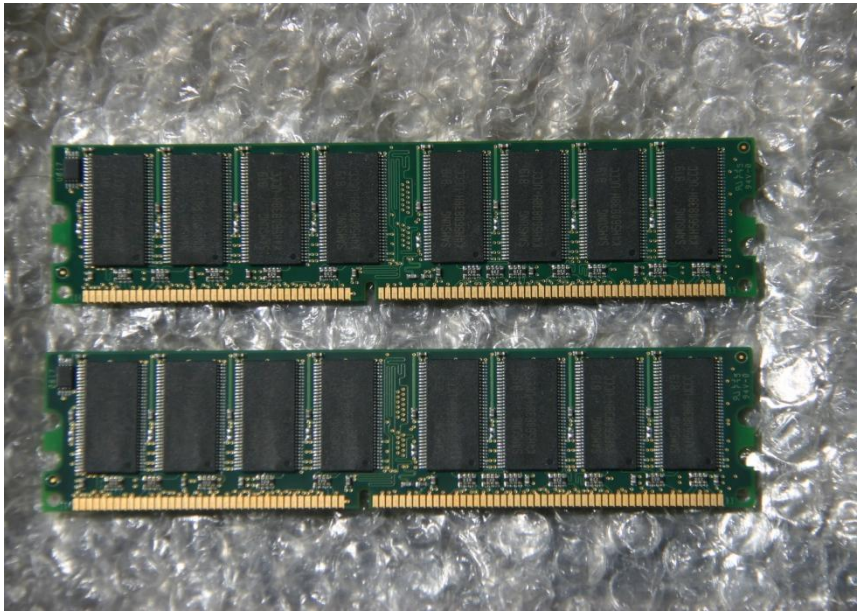
Motherboard with Video Graphics Card removed



Video Graphics Card

Motherboard with Random Access Memory removed

also Video Graphics Card



Random Access Memory (RAM)

front and back views

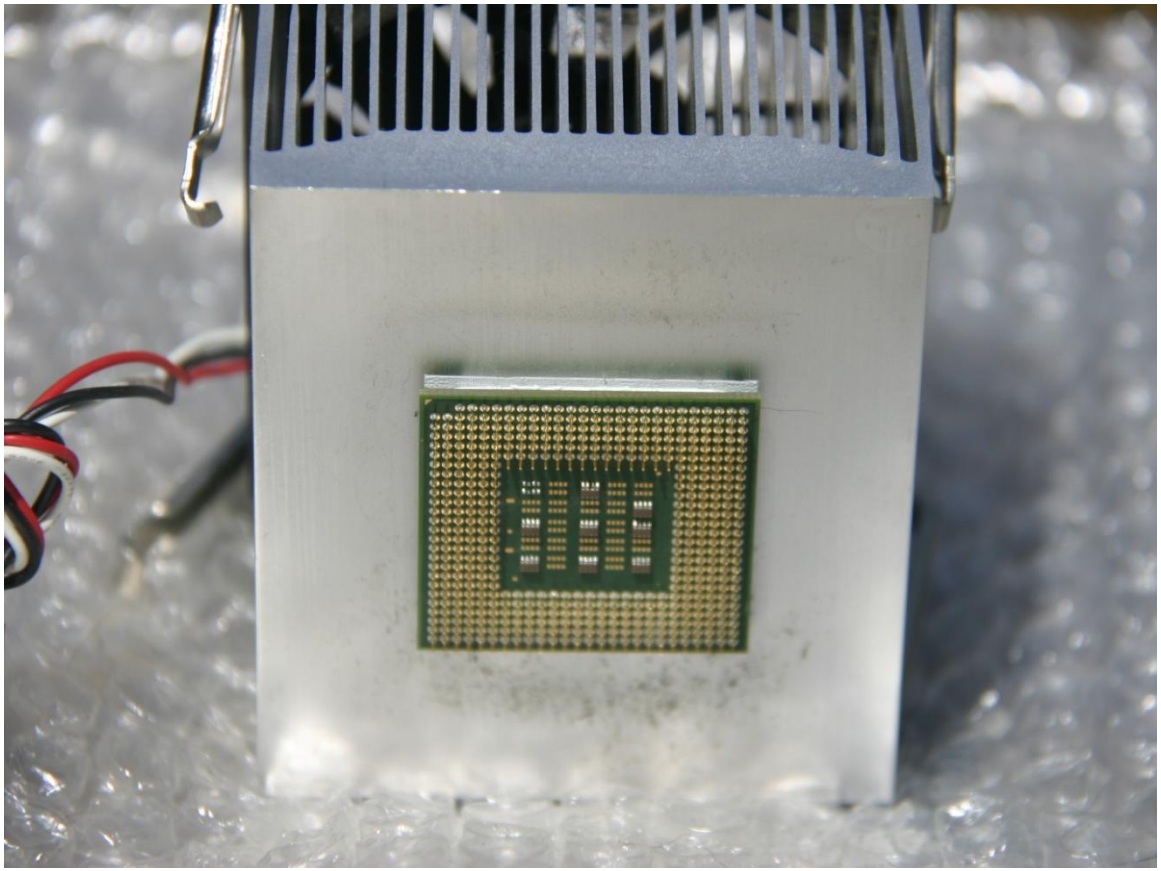
Motherboard with Central Processing Unit (CPU) removed

also Random Access Memory and Video Graphics Card

The CPU is still attached to its Heat Sink.

CPU Heat Sink

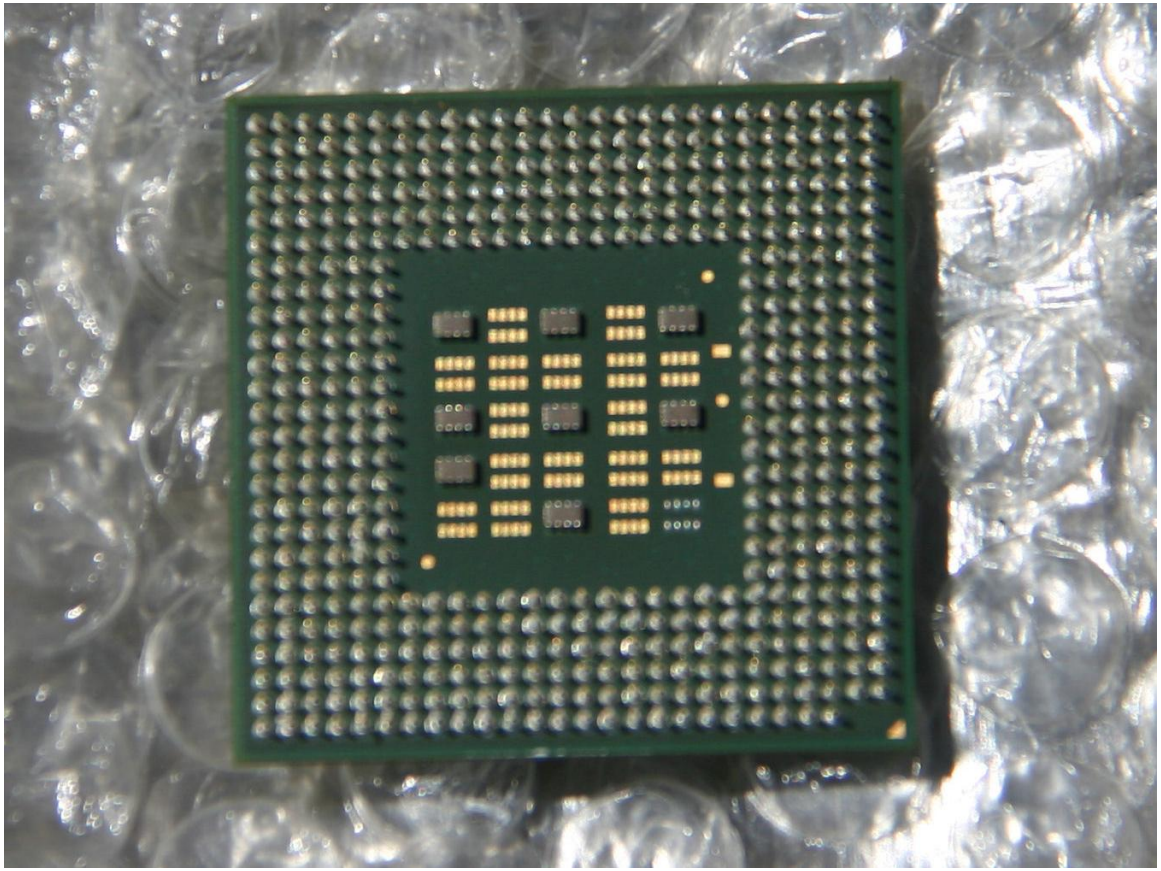
Fan on top, with power cord.



CPU (Pentium 4) with Heat Sink on top

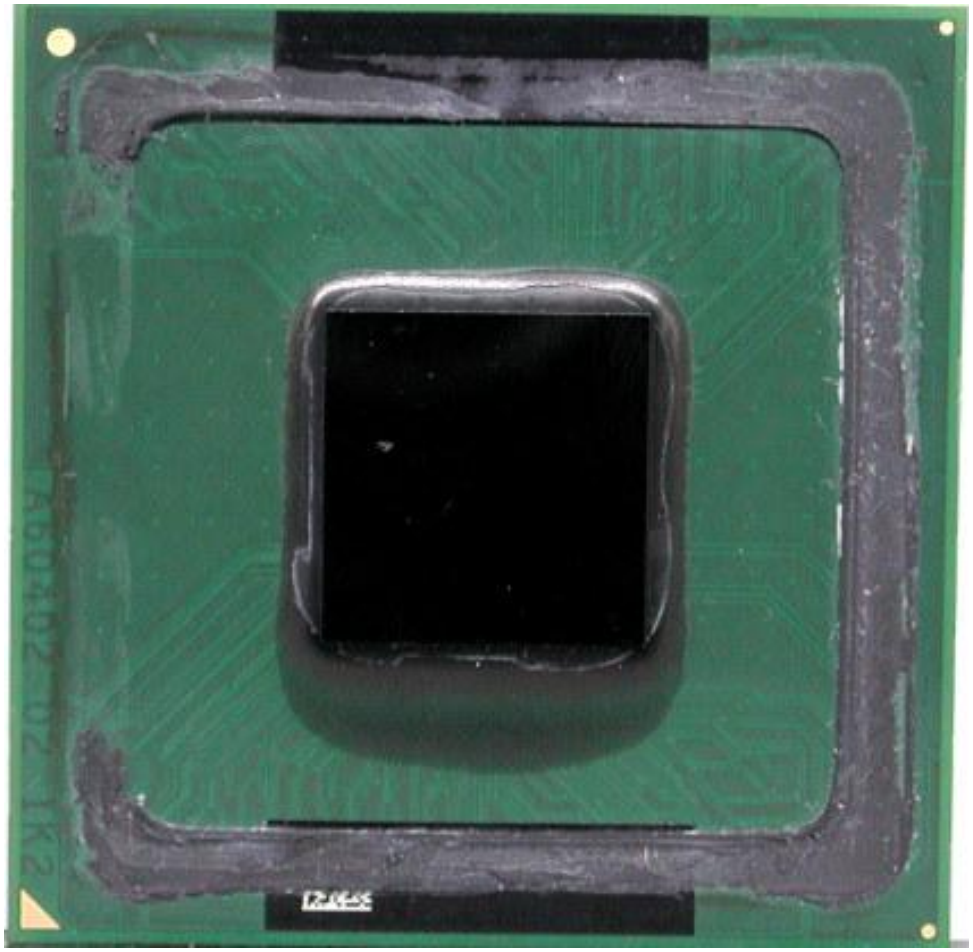
Pentium 4 CPU without heat sink

Top



Pentium 4 CPU

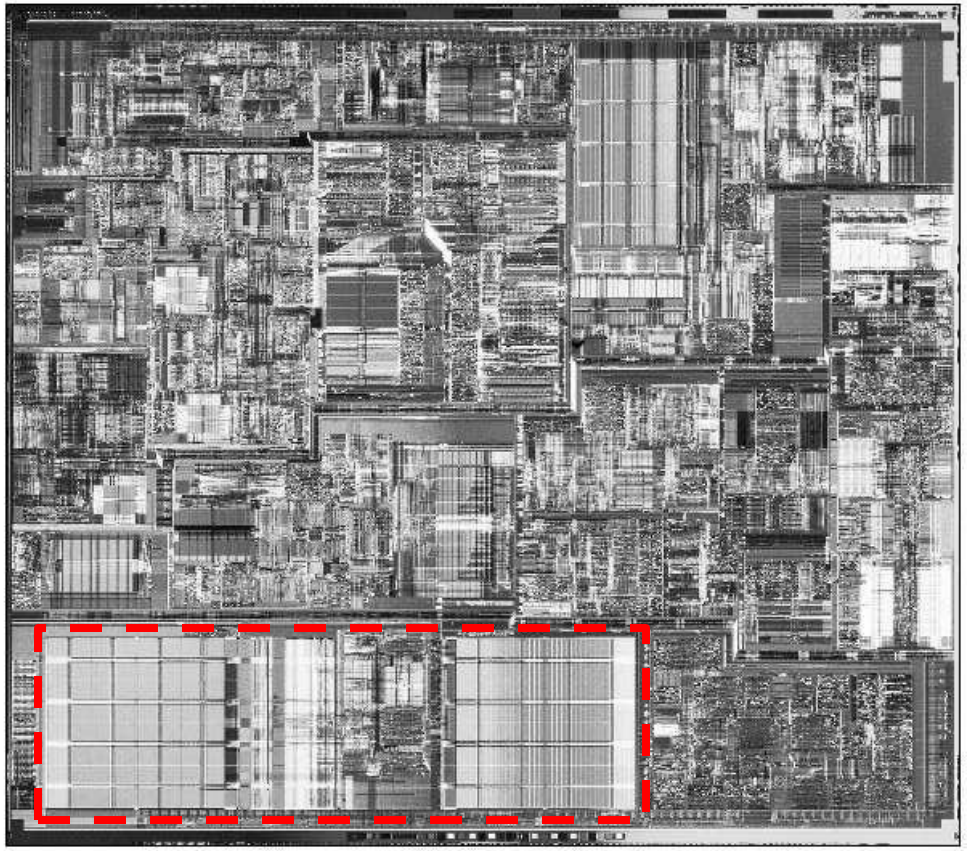
Bottom



Pentium 4 with outer metal case removed

Inner plastic case exposed

Pentium 4 with actual chip exposed



Pentium 4, B&W picture of circuitry on chip

The red box in the lower left surrounds the Cache Memory.

Storage and Memory Access Times

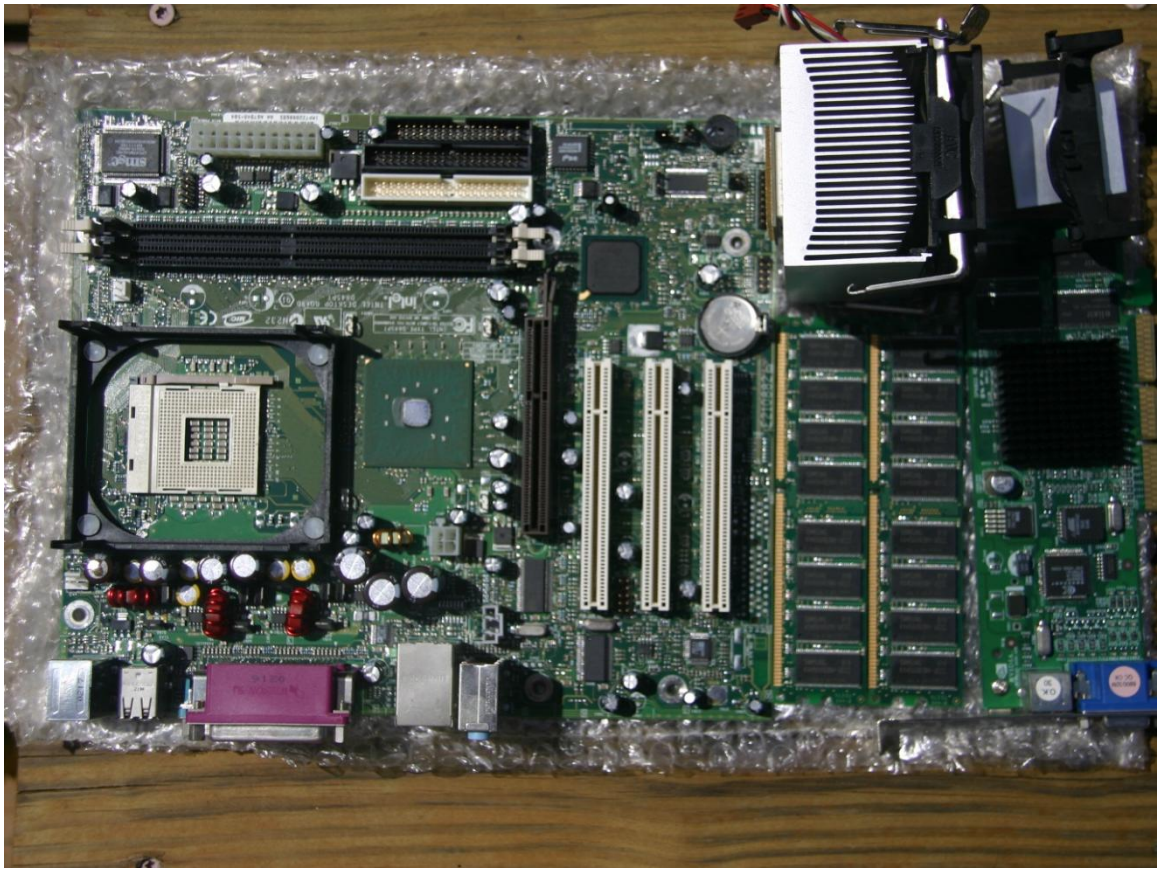
Cloud Storage, on the Internet	fraction of a second	0.x	seconds
Hard Disk Drives and Optical Drives	single milliseconds	0.00x	seconds
Flash Memory	tens of microseconds	0.0000x	seconds
Random Access Memory (RAM)	about 100 nanoseconds	0.0000001	seconds
Cache Memory on CPU chip	fraction of a nanosecond (same speed as CPU)	0.000000000x	seconds

Storage and Memory Costs

Cloud Storage on the Internet	free to the user with advertising (based on Hard Drives)		
Optical Drives	$0.10 per writable disk	0.01	cents per Megabyte
Hard Disk Drives	$100 per terabyte	10	cents per Megabyte
Flash Memory	$40 for 64 megabytes	60	cents per Megabyte
Random Access Memory (RAM)	$20 per gigabyte	2	cents per Megabyte
Cache Memory on CPU chip	(included in CPU, but very expensive to manufacture per byte)		

Storage and Memory Characteristics

Type of memory	Speed	Persistence	Capacity	Portability	Cost
Cloud Storage	very slow	non-volatile	large	easily transported	cheap or free
Hard Disk Drive	slow	non-volatile	very large	rarely transported	cheap
Optical Drive	slow	non-volatile	low per disk	easily transported	moderate
Flash Memory	moderate	non-volatile	moderate	easily transported	moderate
RAM	fast	volatile	low	none	moderate
Cache	extremely fast (CPU speed)	volatile	extremely low	none	very expensive

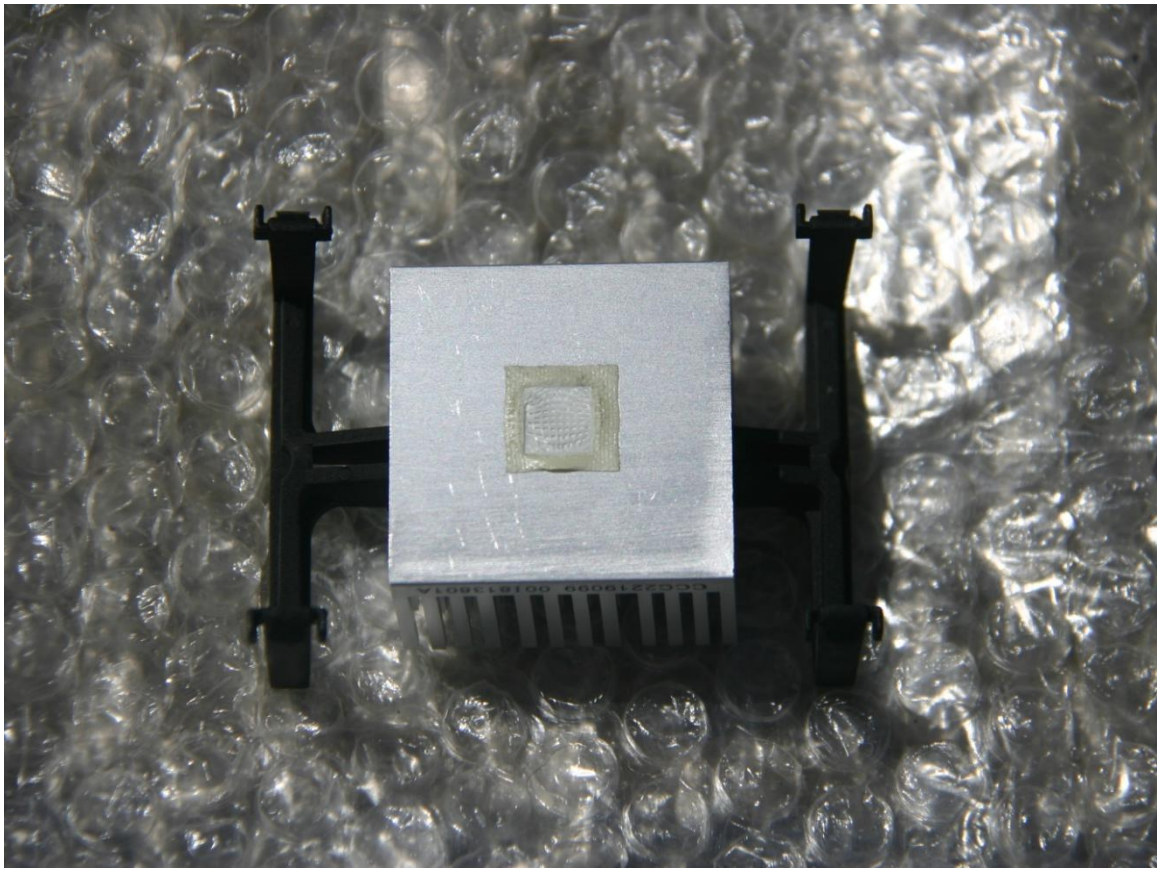


Motherboard with North Bridge Heat Sink removed

also CPU and its Heat Sink, Random Access Memory,
and Video Graphics Card

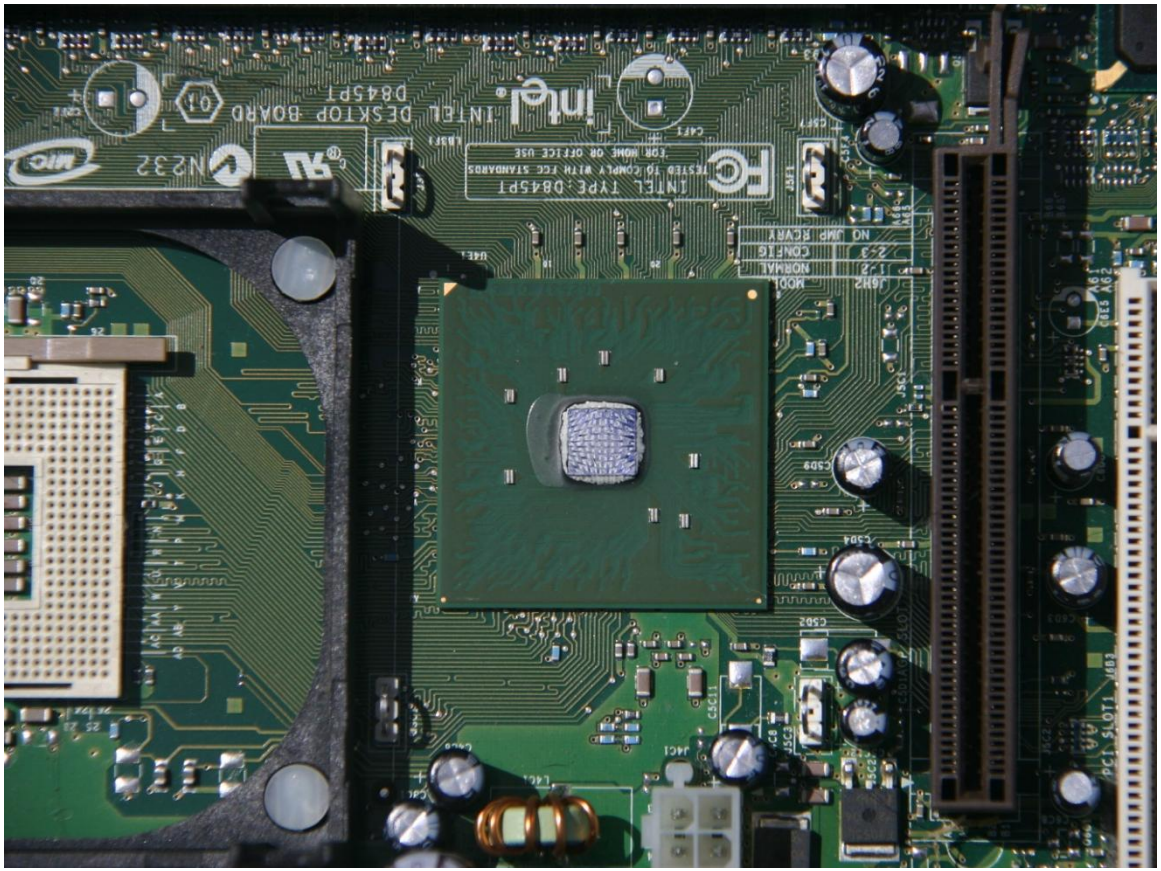
North Bridge Heat Sink

top



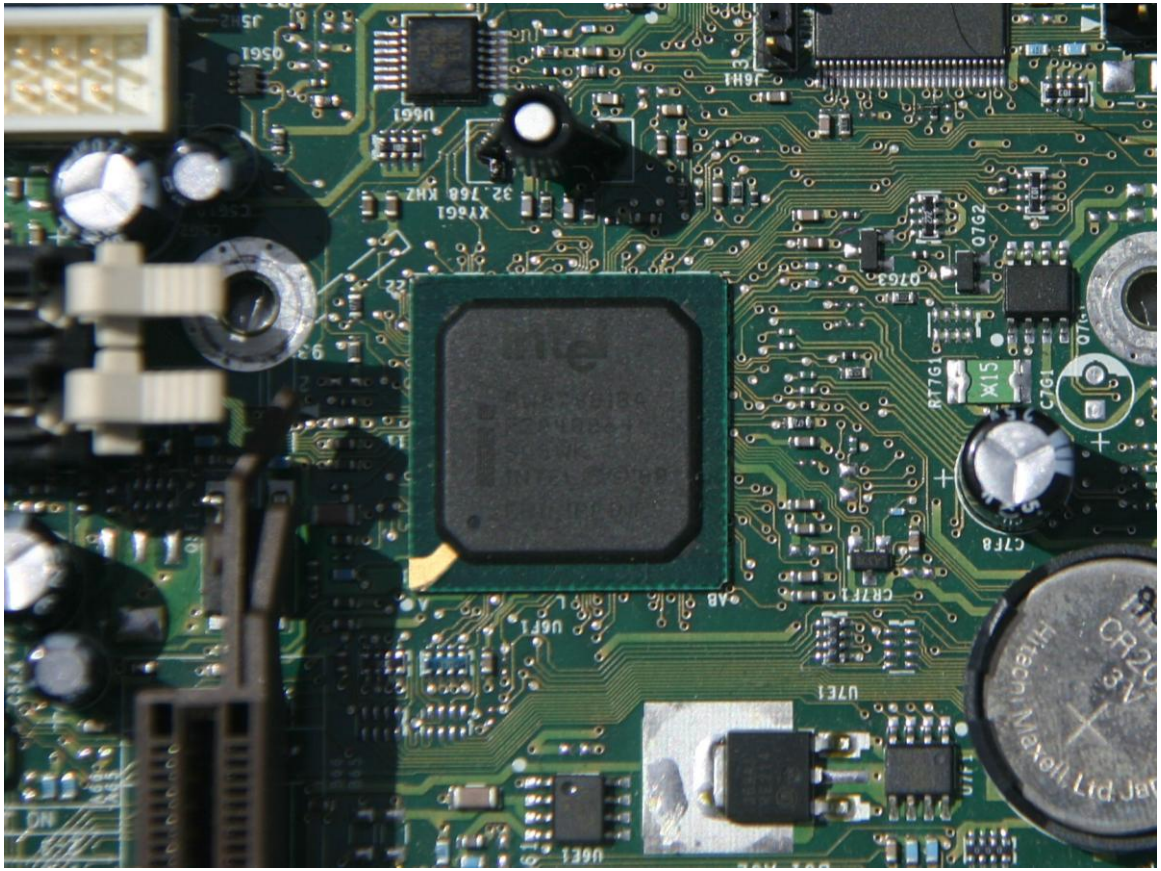
North Bridge Heat Sink

bottom



North Bridge Chip

soldered to the motherboard,
with bus to CPU (left), bus to Video Graphics Card connector (right),
and bus to Random Access Memory (top)

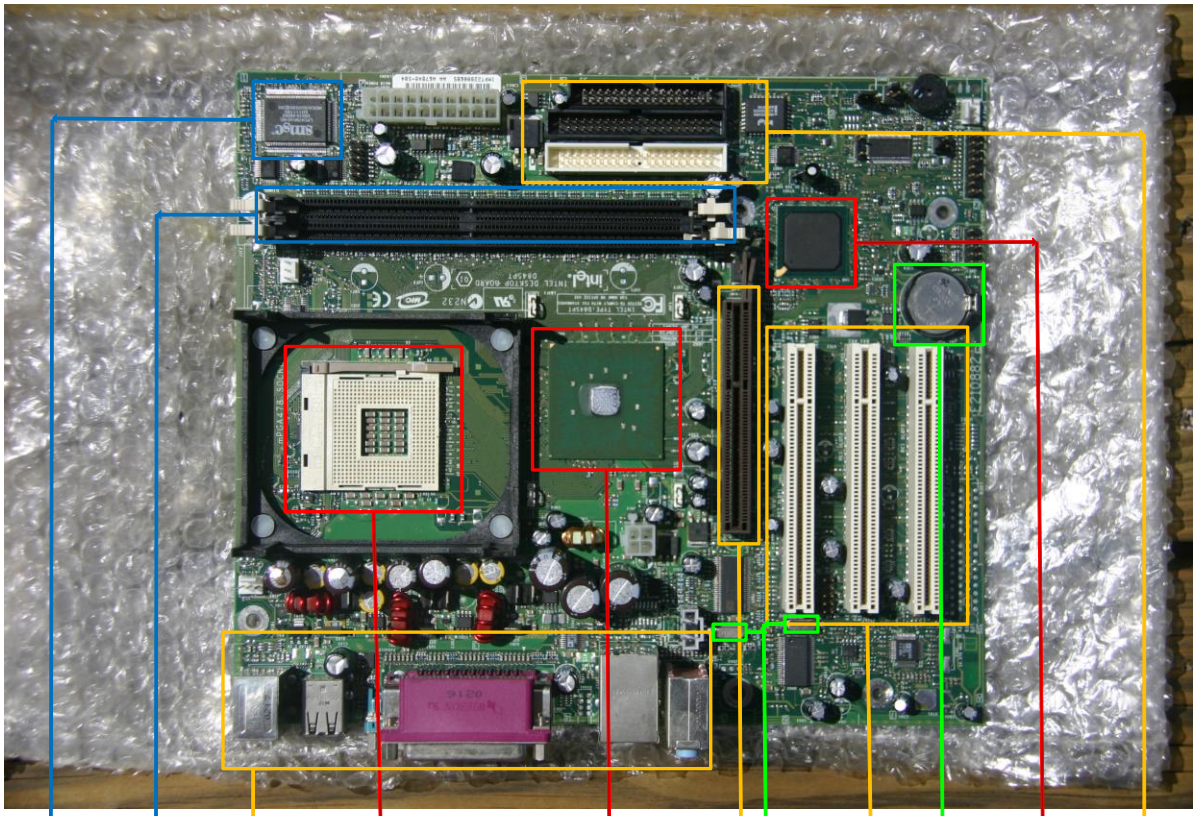


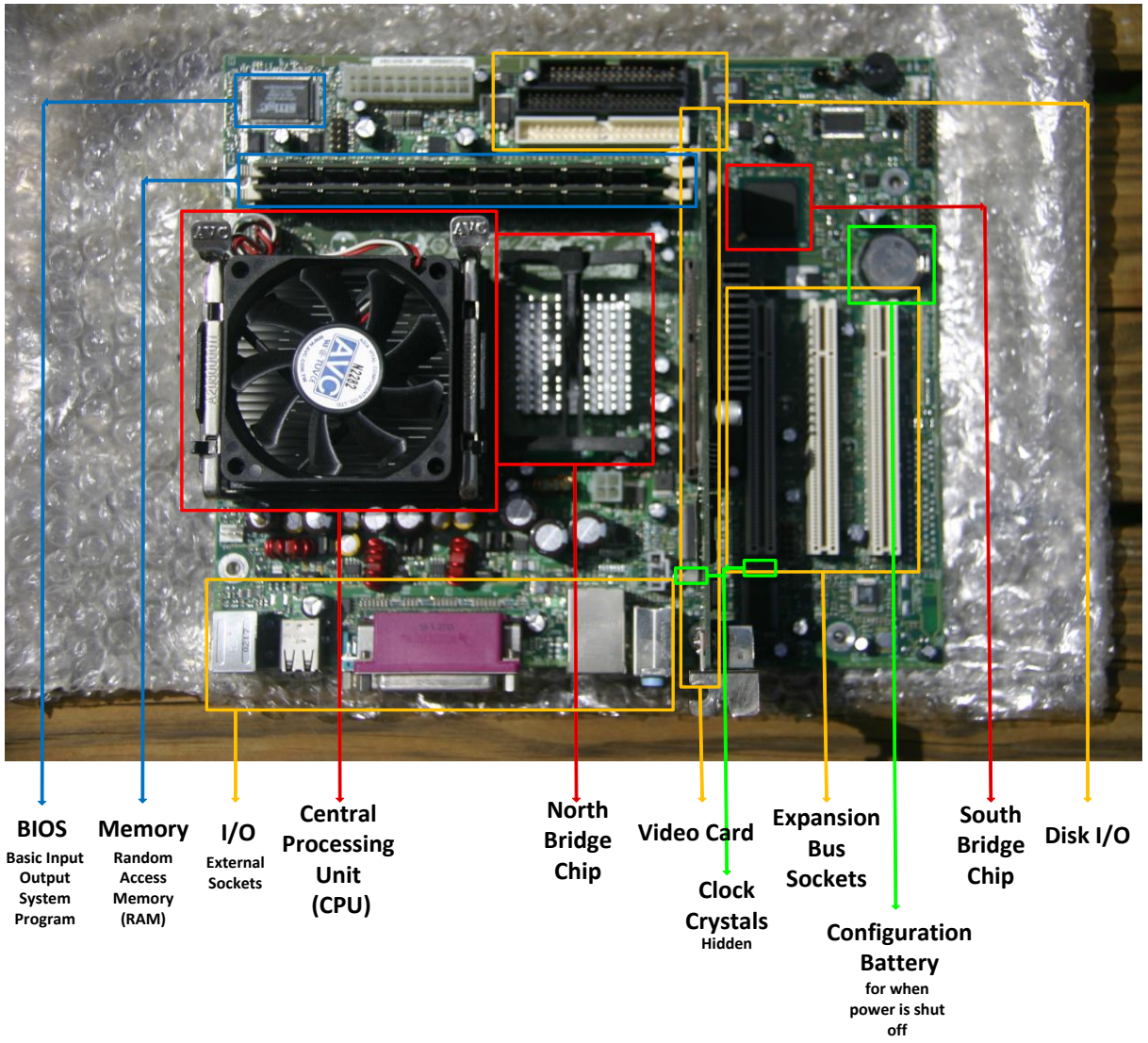
South Bridge Chip

soldered to the motherboard,
controls the slower input / output, including disks, expansion slots,
external connections, and the BIOS (Basic Input / Output System)

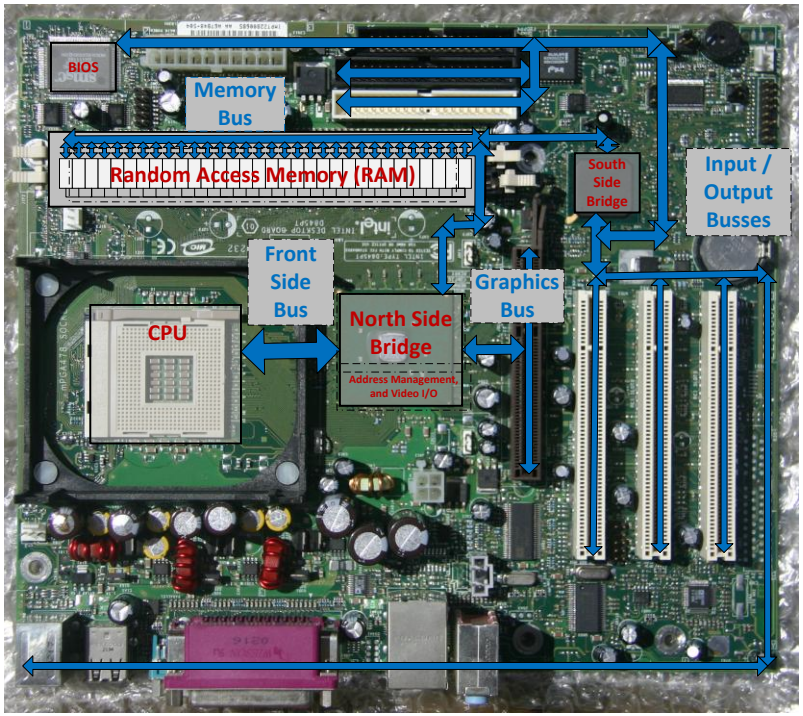
Bare Motherboard

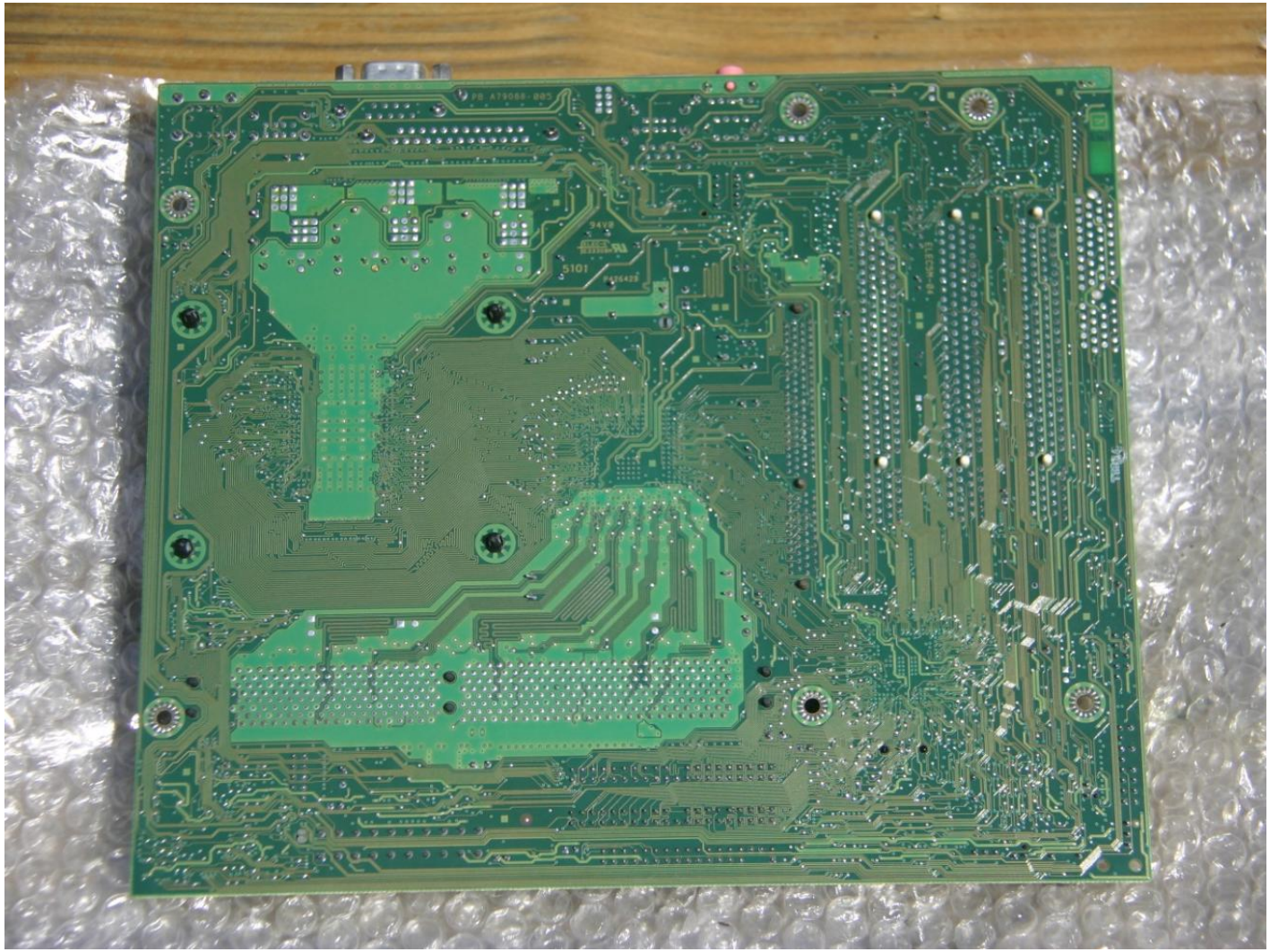
all detachable components removed


BIOS
Basic Input Output System Program
Memory
Random Access Memory (RAM)
I/O
External Sockets
Central Processing Unit (CPU)
socket only
North Bridge Chip
without heat sink
Video Card
Clock Crystals
Expansion Bus Sockets
Configuration Battery
for when power is shut off
South Bridge Chip
Disk I/O

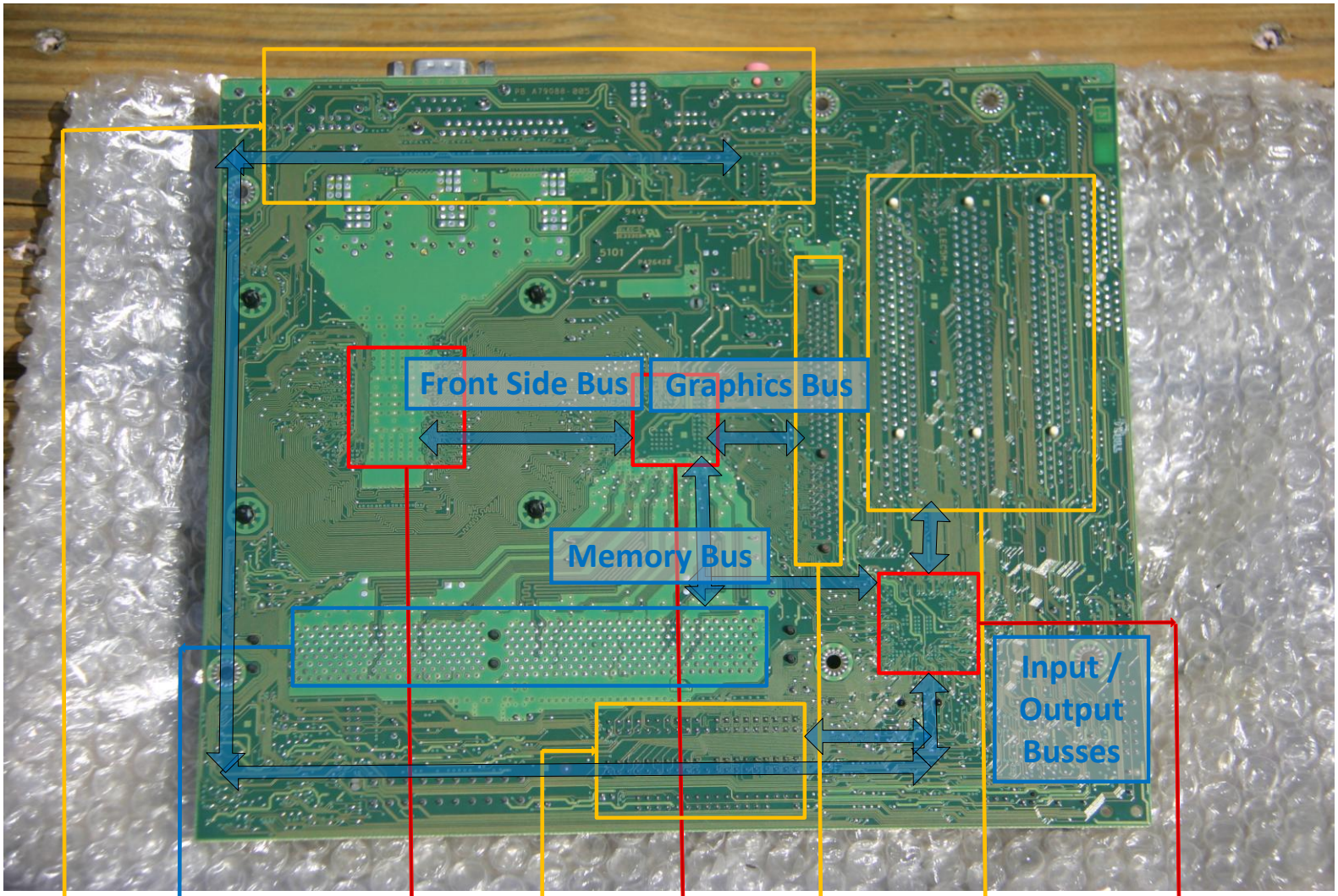


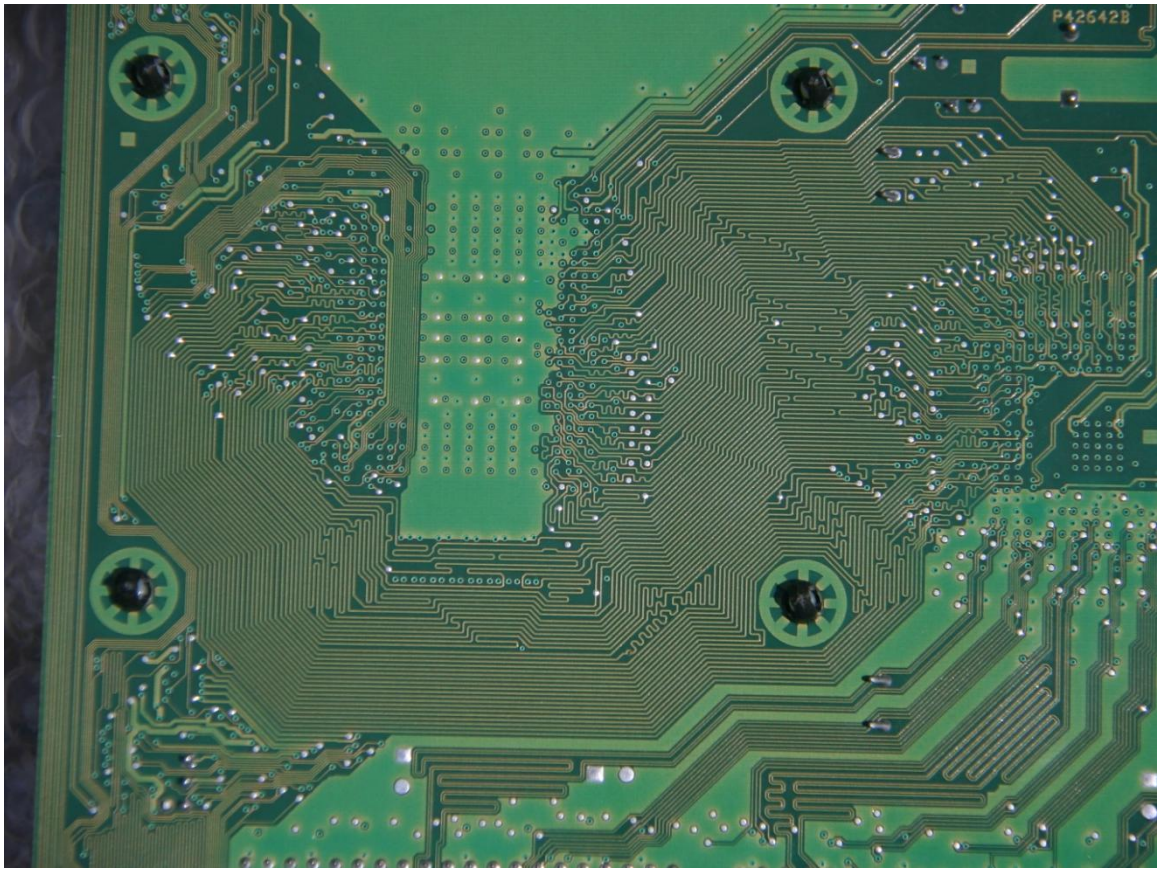
Motherboard with labels, components restored


BIOS
Memory Bus
Random Access Memory (RAM)
South Side Bridge
Input / Output Busses
Front Side Bus
Graphics Bus
CPU
North Side Bridge
Address Management, and Video I/O



Motherboard Underside


Front Side Bus
Graphics Bus
Memory Bus
Input / Output Busses
I/O
External Sockets
Memory
Random Access Memory (RAM)
Central Processing Unit (CPU)
Disk I/O
North Bridge Chip
Video Card
Expansion Bus Sockets
South Bridge Chip



Bus between CPU (in center) and North Bridge chip (on right)

The Nanosecond

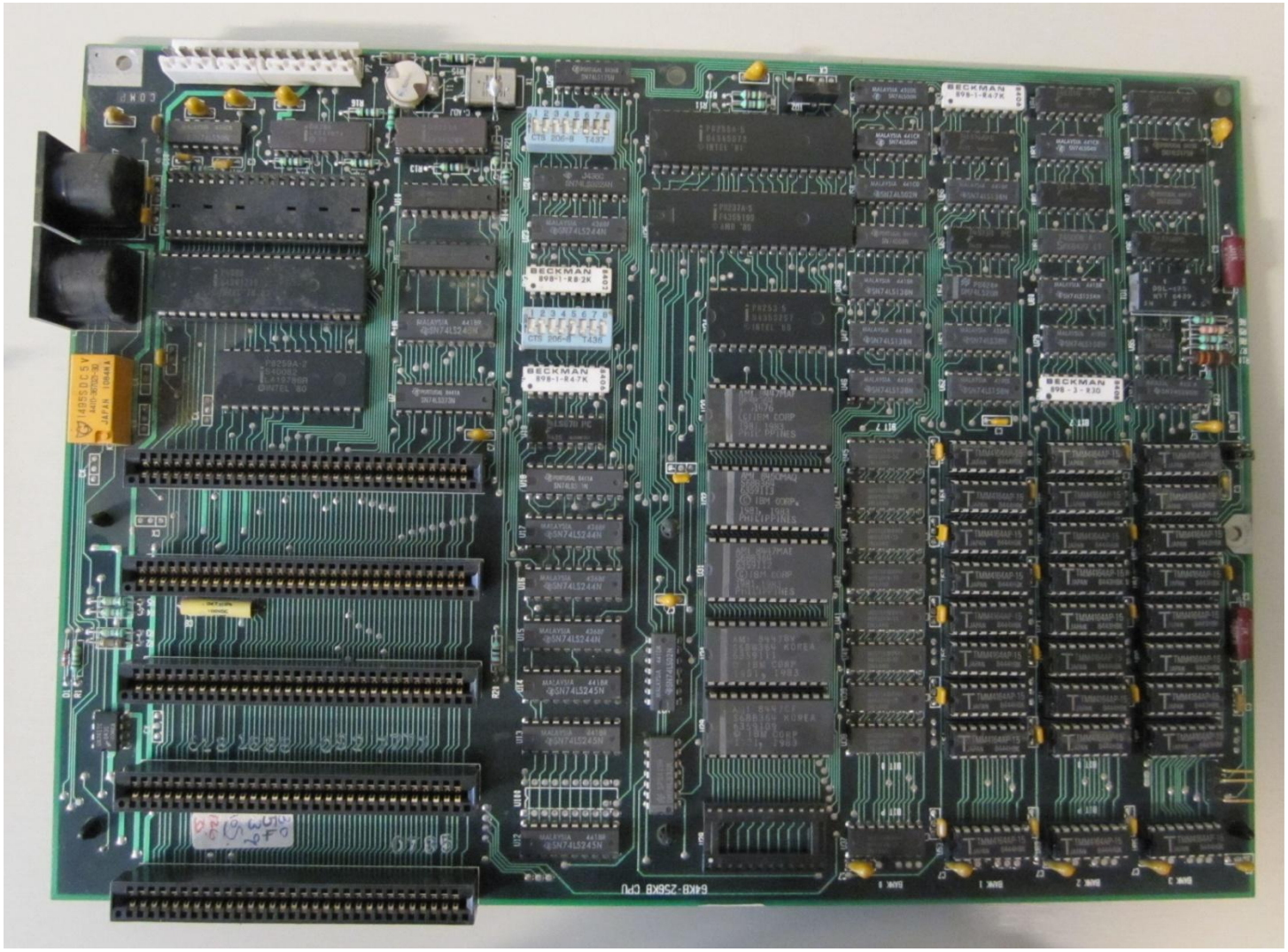
- Electricity in a bare wire goes almost the speed of light.
- Speed of light: about 186,000 miles per second
- 186,000 * 5,280 = 982,080,000 feet per second
- Electricity travels about 1 billion feet per second
- Nanosecond: a billionth of a second
- Electricity travels about 1 foot per nanosecond

The Nanosecond

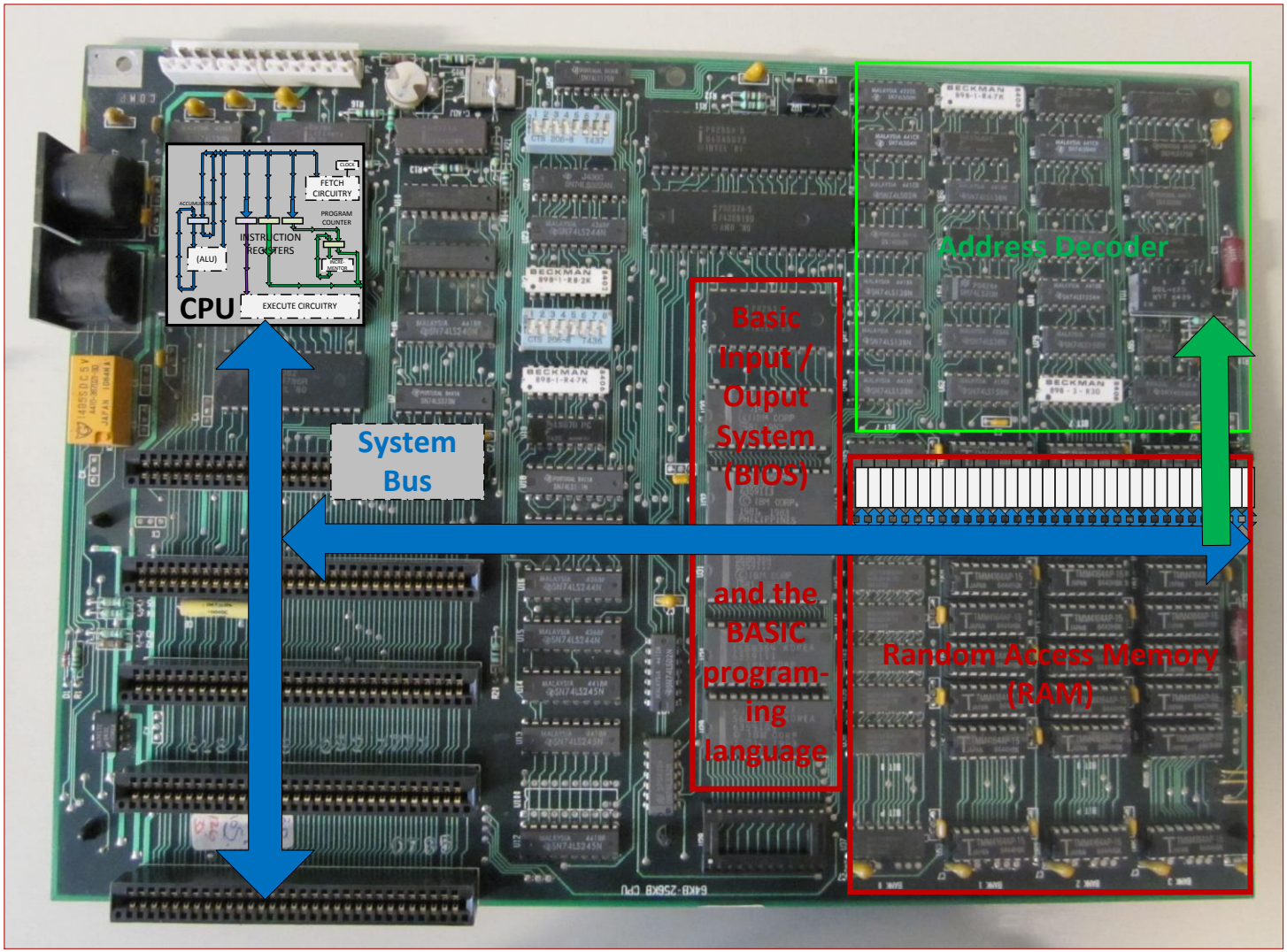
- Clock: currently about 2 GigaHertz
  - 2 billion pulses per second
- Each pulse is about 1 / 2 nanosecond
- 1/2 times 1 foot equals 6 inches
- Electricity travels through a wire:
  about 6 inches per clock pulse
- Much of each clock pulse is “stabilization time”, the time it takes for the electricity to stabilize at a useable value.

The Nanosecond

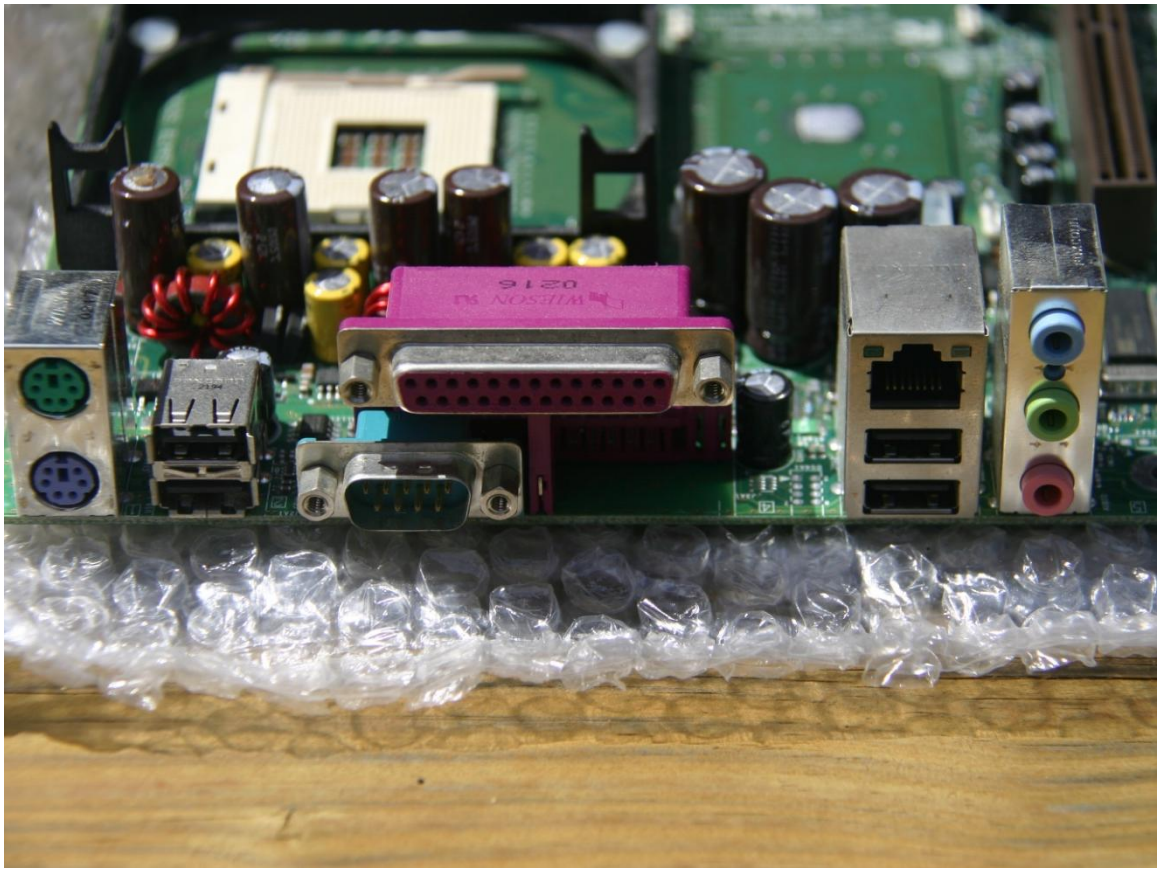
- The moral:
  - The “fast” components on a motherboard must be small and close together.



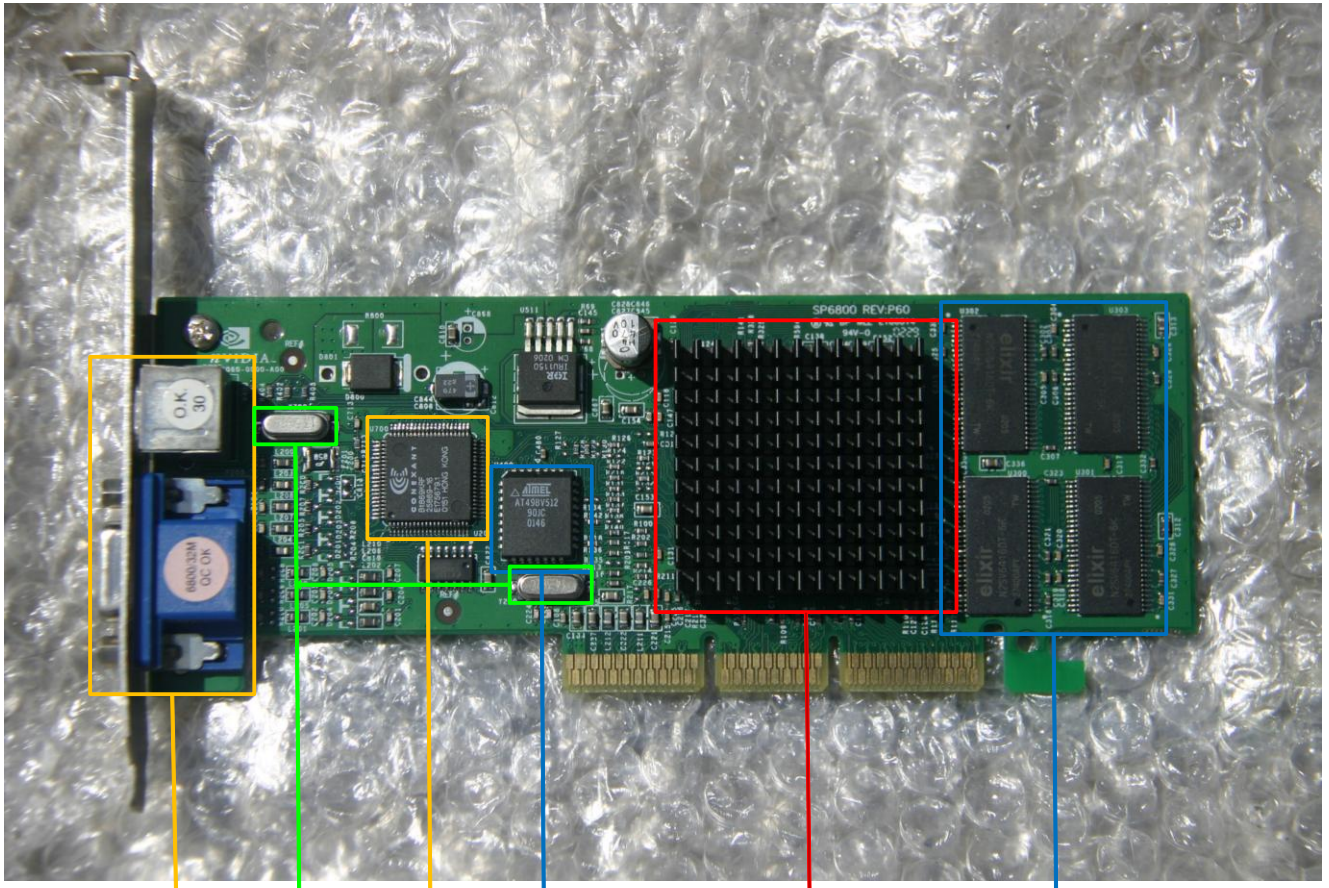
Original IBM PC Motherboard



Original IBM PC Motherboard



Motherboard external Input/Output (I/O) connectors



Video Graphics Card with labels

It is a computer in itself, with the same basic components of the motherboard, specialized for graphics output .

Empty Case

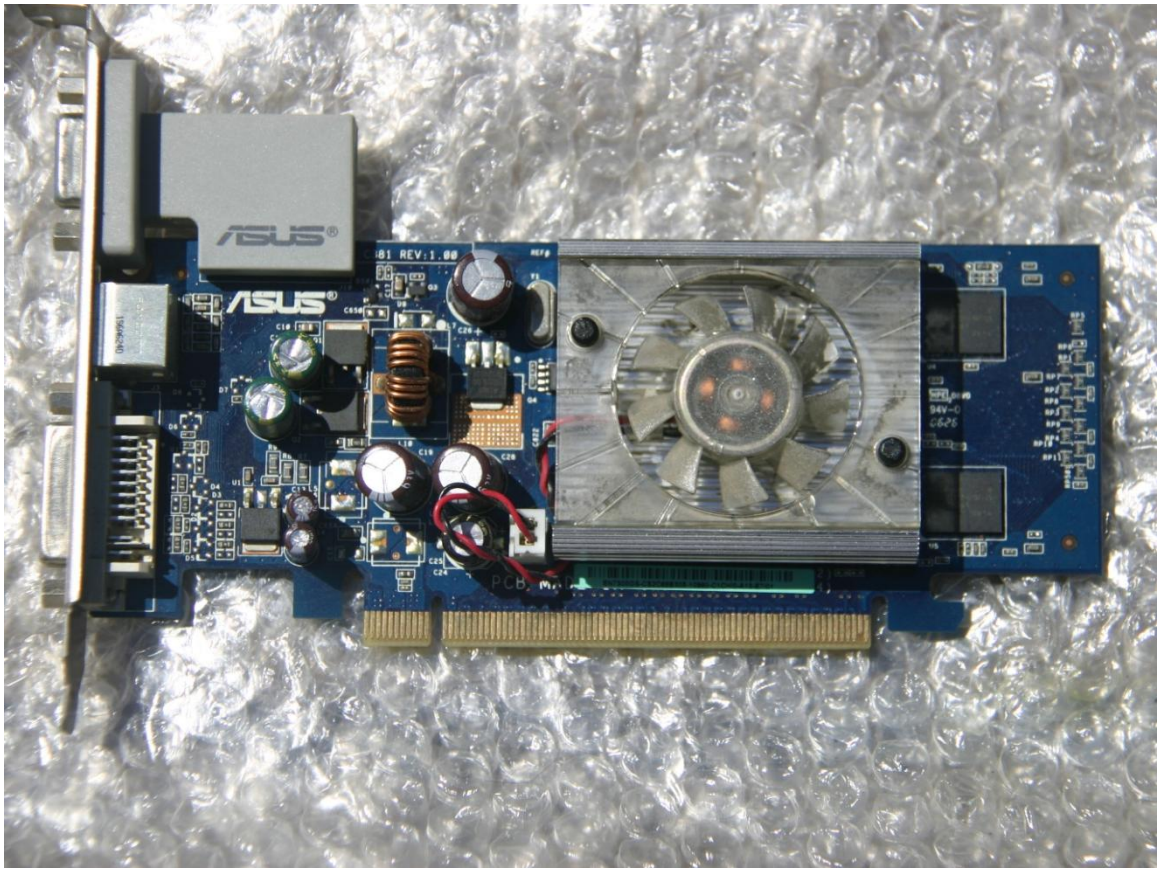
Video Graphics Card with choice of 3 connectors

VGA on left, S-Video in center, DVI on right

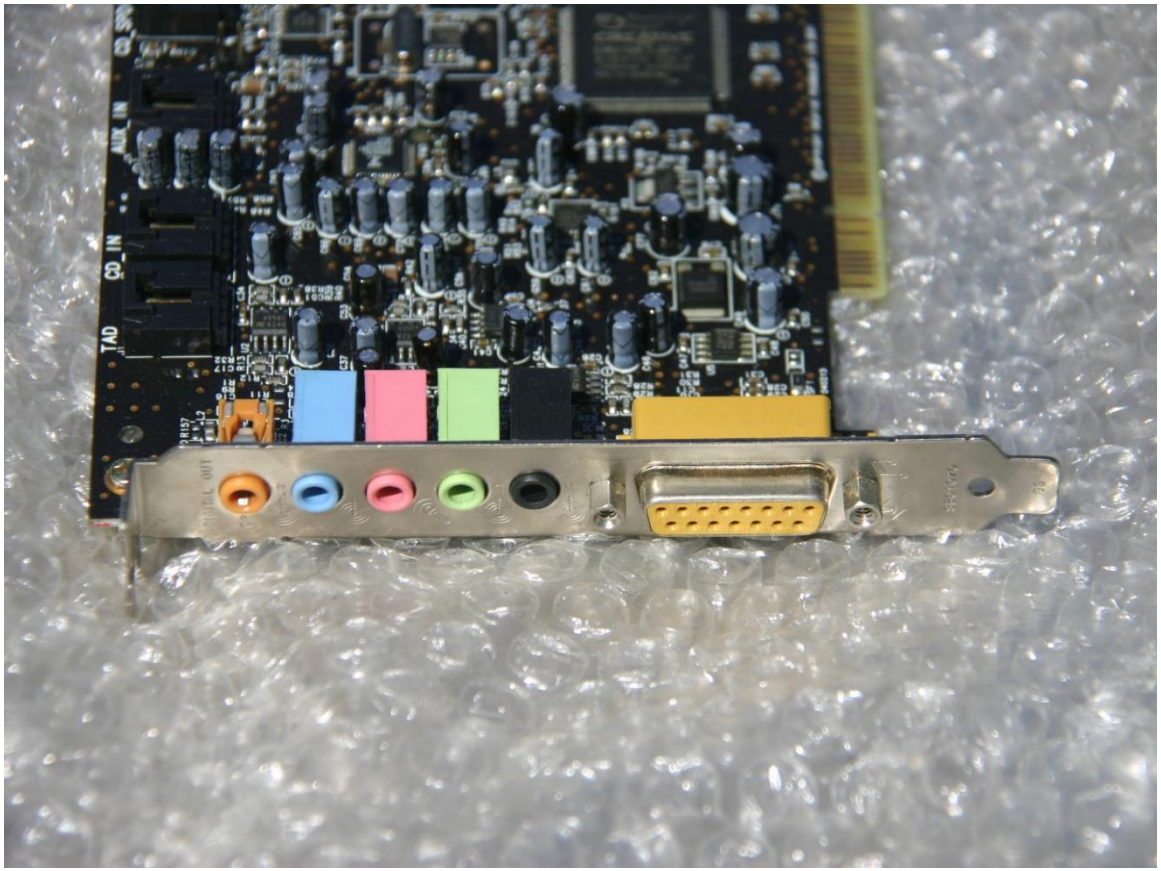
VGA: Video Graphics Array, 1980's to present, from computer technology

S-Video, Super-Video, 1980's to present, from television technology

DVI – Digital Video Interface, 1999 to present, backwards compatible



Video Graphics Card

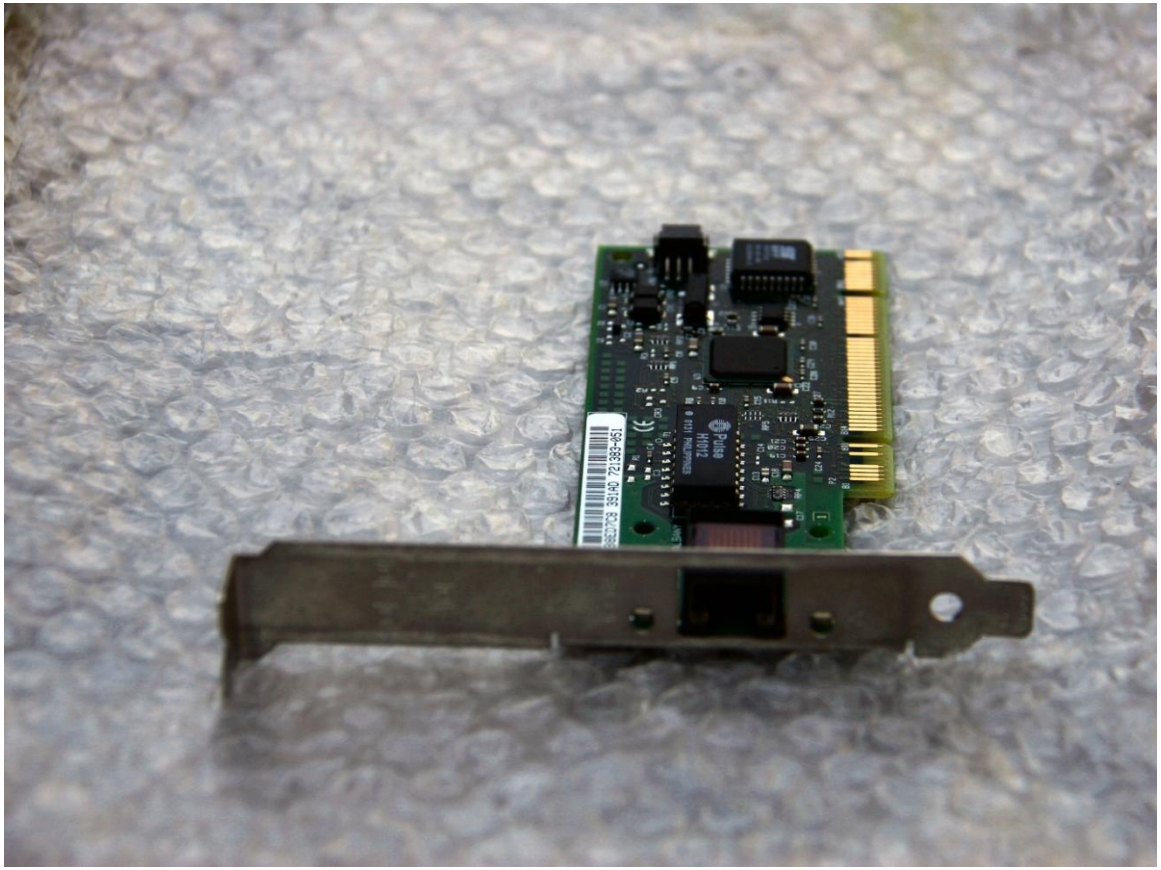


Audio Card

5. 1 Audio Output

Audio Card

Notice CD input at top, for the sound cable from the Optical Disk Drive

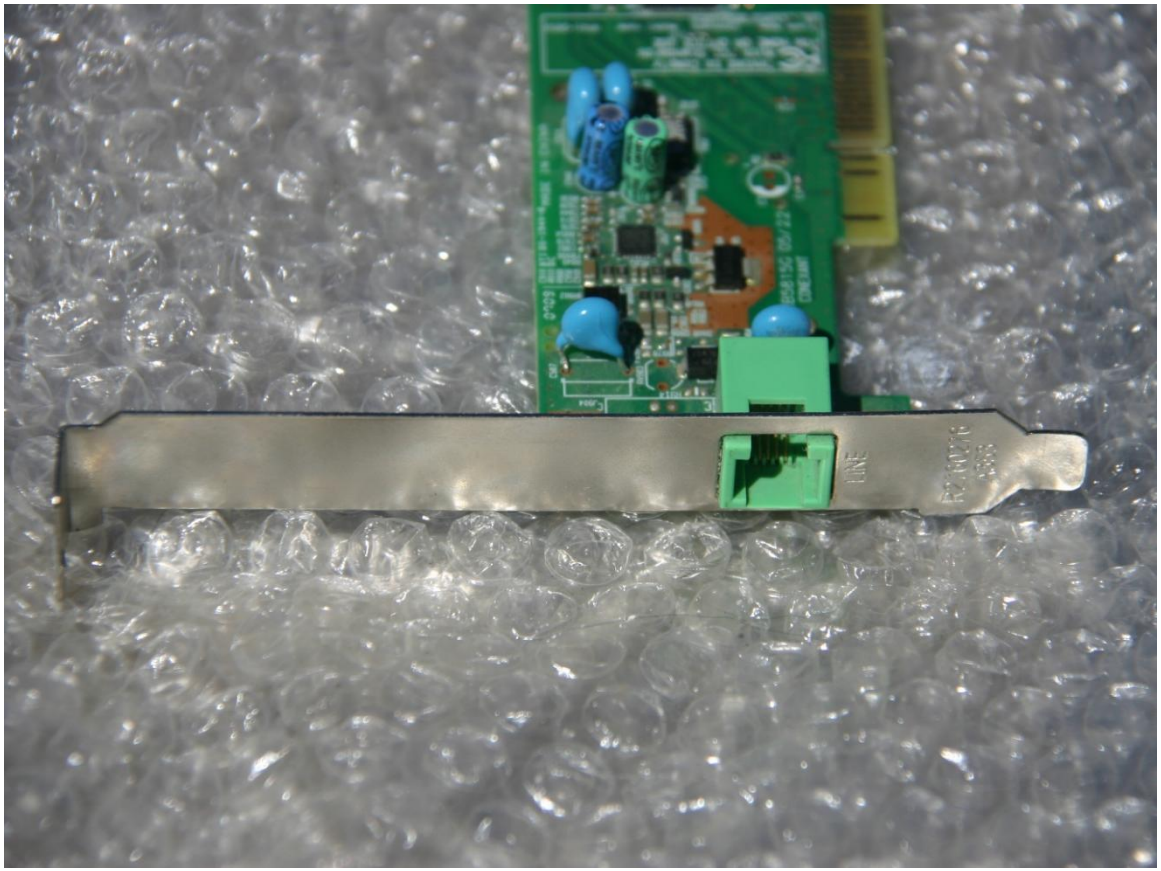


Network Card

Ethernet

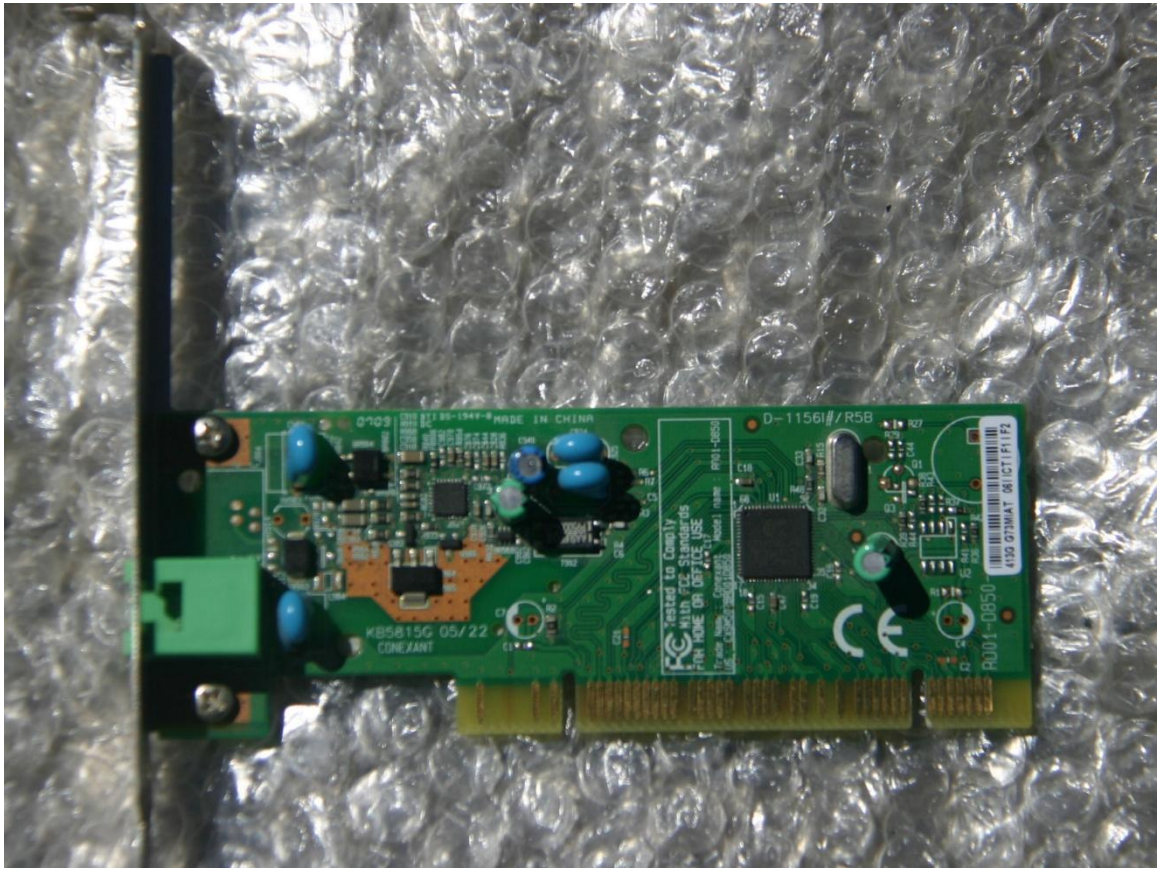
Network Card

wired Ethernet connector



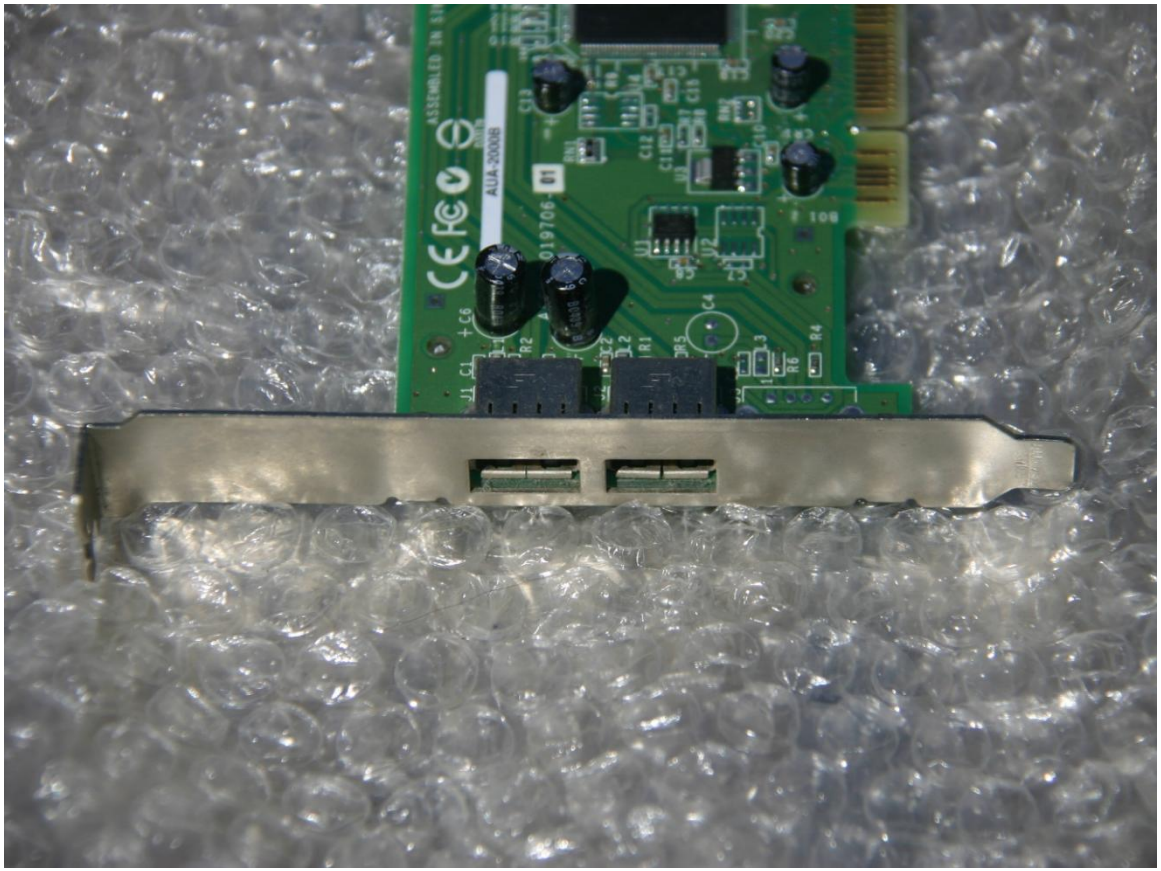
Modem Card

for land line telephone connection



Modem Card

for land line telephone connection



USB Expansion Card

adds two Universal Serial Bus connections that have direct access to the motherboard input / output bus

USB Expansion Card

End of Presentation