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**EN2031 - Fundamentals of Computer**  
**Organization and Design**

**Dissectors**  
**Motherboard Dissection Report**

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# Abstract

The motherboard is one of the most important parts of a computer system, that establishes the connection between different components of a computer. Our report contains the dissection of ASUS at4nm10t-i motherboard. We inspected the main components and their key specifications, interconnection between the main components, access speeds of IO components, connectivity, and cooling options available in this motherboard.

ASUS at4nm10t-i motherboard consists of ,

1. Intel® Atom D425 processor
2. Intel® NM10 chipset
3. 2 204-pin SO-DIMM sockets
4. Intel® 3150 Graphics Media Accelerator
5. PCIe X4 expansion slot
6. 4 x Serial ATA 3Gb/s ports support AHCI mode
7. VIA High Definition Audio 6-channel CODEC
8. Realtek RTL8111E PCIe Gigabit LAN controller

This motherboard supports up to 6 USB 2.0 ports. This even has ASUS special features like ASUS CrashFree BIOS 3, ASUS EZ Flash 2, ASUS MyLogo 2TM.

# Introduction

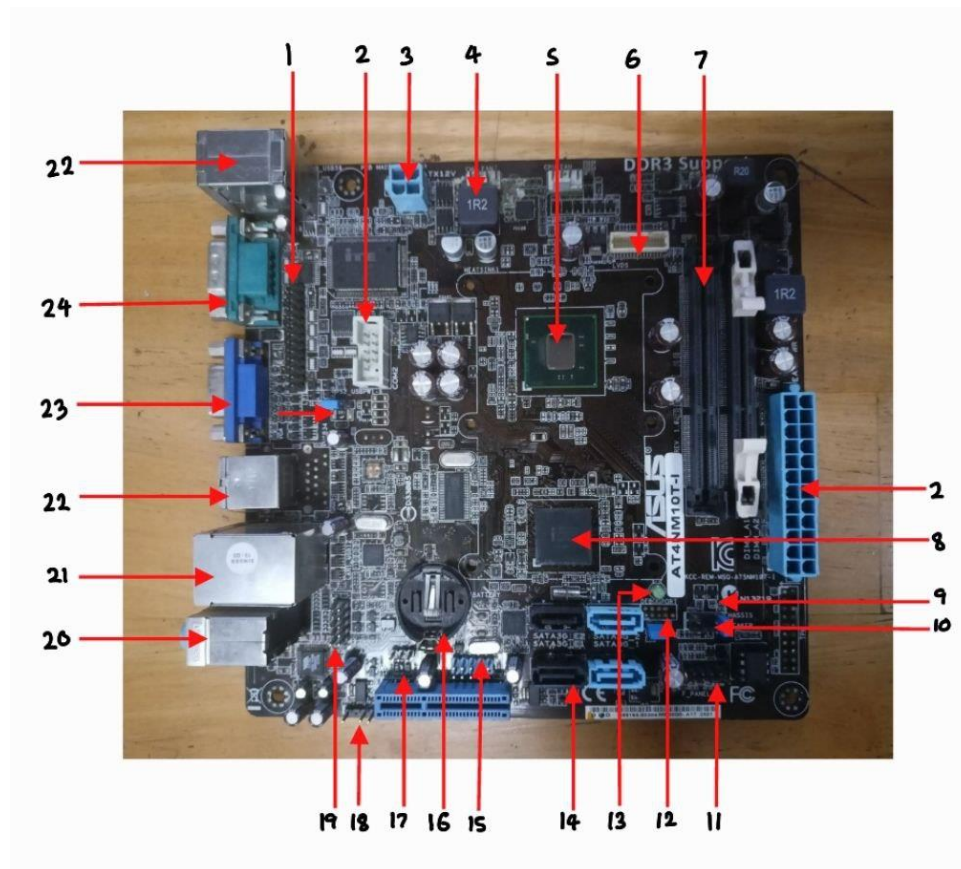
The main printed circuit board in a computer is known as the motherboard. The motherboard connects electronic components such as RAM, CPU, and GPU. Aside from that, it offers connectivity options for the external input and output devices that we connect to our computer. We can also use the expansion slots on our motherboard to upgrade our computer. The CPU is the computer's brain, and it is directly connected to the motherboard. The motherboard's chipset serves as the interface between the motherboard and the CPU. So, when dissecting the motherboard, we had to consider these key specifications and other important factors.

We selected ASUS at4nm10t-i motherboard for the motherboard dissection project. This is a motherboard made by ASUSTek Computer Inc. ASUS is a Taiwanese multinational computer hardware and electronics company principally engaged in the manufacture and distribution of computers, communication products and consumer electronics. ASUS is a well-known brand that is generally considered to build reliable and functional motherboards. Using high quality material and electronic components with a long life span make the ASUS motherboards more reliable and stable. This report presents the dissection of ASUS at4nm10t-i motherboard.

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# 1.Motherboard Layout



1 LPT connector (26-1 pin LPT)	13 Onboard LED
2 Serial port connector (10-1 pin COM2)	14 Serial ATA connectors (7-pin SATA3G 1, SATA3G 2, SATA3G E1)
3 ATX power connectors (24-pin EATXPWR, 4-pin ATX12V)	15 USB connectors (10-1 pin USB78)
4 CPU and chassis fan connectors (4-pin CPU FAN, 4-pin CHA FAN)	16 Lithium cell CMOS power
5 Intel Atom D425 processor	17 Digital audio connector (4-1 pin SPDIF OUT)
6 LVDS connector (30-pin LVDS)	18 Keyboard/mouse power and USB device wake-up (3-pin PS2 USBPW1-6, 3-pin USBPW7-8)
7 DDR3 DIMM sockets	19 Front panel audio connector (10-1 pin AAFP)
8 Intel NM10 chipset	20 Audio port
9 Chassis intrusion connector (4-1 pin CHASSIS)	21 Ethernet LAN port
10 Internal speaker connector (4-pin SPEAKER)	22 USB ports
11 System panel connector (10-1 pin F_PANEL)	23 VGA port
12 Clear RTC RAM (3-pin CLRTC)	24 COM port

## 2.Main Components

### 2.1 Memory Components

#### 2.1.1 RAM

RAM stands for Random access memory. RAM allows the applications to temporarily store and retrieve data for a short term. This is a volatile memory; therefore, the data will be lost once the computer shuts down. Today, most computers use SDRAMs (Synchronous Dynamic Random Access Memory), which synchronises with the system clock for faster data access.



This motherboard is compatible with two SODIMM DDR3 SDRAMs with maximum total memory of 4G. The ram clock speed supported by the system is 800Mhz. And the system supports only non-ECC ram modules meaning the ram modules contains 8 memory chips array without the presence of an additional memory chip which is responsible for checking for errors and correcting them.

#### 2.1.2 ROM

ROM (Read Only Memory) is an integrated circuit programmed with certain data including BIOS, and first start up instructions such as initializing the hardware elements, running self-tests, and loading Operating system into the ram at the power up of the computer. And ROM is a non-volatile memory unlike the Ram therefore it



does not need power to retain its content.

This motherboard includes a 8Mb EN25F80 Serial Flash memory as the ROM. Flash Rom has the electrically

erasable and programmable capabilities (EEPROM) and also can read data quickly without power loss (the advantage of NVRAM).

#### BIOS

This motherboard has an AMI BIOS system from the AMI company integrated in the ROM. BIOS identifies, configures tests, and connects computer hardware to the OS after a computer is turned on. This is called the boot Process. BIOS is part of motherboards hardware; therefore it does not depend on the Operating System installed on the computer. Irrespective of whether an OS installed or not BIOS function outside of the operating system environment.

### 2.2 Processing Components

#### 2.2.1 Processor

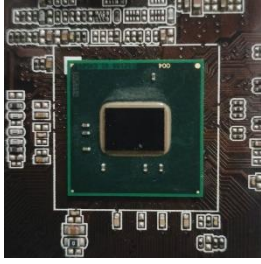
A processor or it is called a Central Processing Unit (CPU), is the brain of a computer. It's a small chip that executes instructions and performs calculations necessary for a computer to function. The speed and efficiency of a processor significantly impact a PC's performance. It has mainly three parts named Arithmetic and Logic unit, Control unit & registers.

A faster processor allows a computer to process data and run applications more quickly. It enhances multitasking capabilities, enabling smoother performance when running multiple programs simultaneously. Additionally, modern processors often come with multiple cores, which further boosts multitasking and overall system performance.

The processor's architecture and manufacturing process affect its performance. Cutting-edge processors employ smaller nanometre technology, which enhances speed and power efficiency. Features like cache size, clock speed, and hyper-threading also play vital roles in determining a processor's capabilities.

#### 2.2.2 Intel Atom D425 Processor

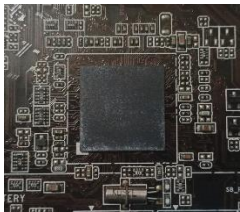
The ASUS AT4NM10T-1 motherboard includes this type of processor. The main thing is that the Intel Atom category is the smallest processor category in the world. The Intel Atom D425



processor has 1 CPU core and 1.8GHz frequency. It needs 10 watts of power to run. Then its size is 2.2cmx2.2cm as well. It was introduced on June 21, 2010. Actually, it is a very complex processor. It has been connected to

the motherboard with more complexity. And the special thing is that there is a chipset named Intel NM10 to work with the Intel Atom processor. Both are soldered to the motherboard.

### 2.2.3 Intel NM10 Express Chip Set



The motherboard chipset is Intel NM10 Express. It provides additional upgradability and flexibility to the processor with two slots of single channel DDR3 memory at

800 MHz Mainly, it is a supporter, and it supports memory up to 4GB maximum.

## 2.3 GPU

The Graphics Processing unit (GPU) on a motherboard is an integrated graphics chip attached to a computer's motherboard. Modern motherboards do not integrate any onboard graphics processing chip into the motherboard itself as a separate chip. Instead, the integrated graphics card is found on a CPU. So, motherboards now depend on the CPU to power up their video output function. Without a separate graphics card, it performs the function of a graphics processing unit, rendering pictures and videos for the computer's display.

In low-priced or entry-level systems, including laptops and some desktops, motherboard GPUs are frequently encountered when space, power, or cost constraints make it impracticable to incorporate a discrete graphics card. Although motherboard GPUs may not provide the same level of performance as standalone graphics cards, they are enough for common computing tasks like web browsing, office programs, and multimedia playing. Additionally, they are power-efficient and aid in preserving battery life

in portable devices like laptops. A dedicated graphics card is typically chosen for its incredible speed and visual quality in games and other graphically demanding applications.

## 2.4 Network Adapter

A Network adapter allows the computer to connect to an external network through wired or wireless media. For wired connection RJ45 ethernet cable can be used and for wireless connection Wi-Fi technology is used. Traditional Network interface card (NIC) which was the standard network adapter used for wired communication was standard to be connected externally to the motherboard early days but now most motherboards come with an integrated NIC card. This integrated NIC card is known as the Ethernet controller and now it comes in the form of a single chip due to the development in the technology. This motherboard also has an integrated NIC in the motherboard.

### 2.4.1 Ethernet Controller Chip

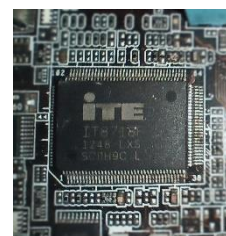


This motherboard comes with an RTL811E chip as its ethernet controller chip. The chip is capable of providing high speed transmission of up to 10 Mbps over CAT 5 UTP (Category 5 Untwisted Transmission Pair) cable or

CAT 3 UTP cables. In order to provide reliable communication at higher speeds, the chip comes with functions such as Auto correction, timing recovery and error correction etc.

## 2.5 Other Integrated Circuits

### 2.5.1 Super I/O Chip



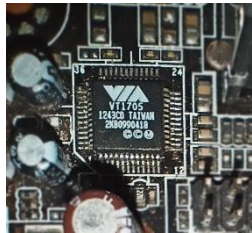
Super Input Output chip is responsible for handling slower and less prominent input output devices such as Floppy Disk controller, Parallel Port, Keyboard and Mouse (Non USB), Real Time Clock(RTC),

Temperature sensor and fan Speed etc. Early days, this chip used to communicate through ISA



and PCI busses but in modern motherboards the chip communicates through the South bridge. This motherboard uses a IT8718F chip as its Super I/O chip developed by iTE.

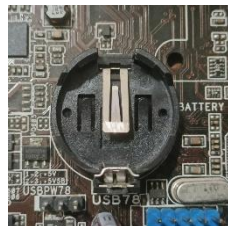
### 2.5.2 Audio Controller Chip



This motherboard uses the VT175 chip as its audio controller chip. The chip is capable of operating on low power while producing high fidelity audio using 6 channel High definition Codec. It supports audio sample rates up to 192Khz.

## 2.6 Battery

The small battery on a motherboard, commonly known as the CMOS battery, serves a critical function in a computer system. It's typically a coin-cell battery, most commonly a CR2032, and has the following duties.



The CMOS battery is essential for retaining basic system information and settings stored in the BIOS (Basic Input/Output System). These settings include date, time, boot order, and hardware configurations. Without the CMOS battery, these settings would reset every time the computer is powered off. Then it powers the real-time clock, which keeps track of the current date and time even when the computer is powered off. This information is crucial for file timestamping, scheduling tasks, and other time-related functions.

## 3 I/O Ports

### 3.1 Back Panel I/O Ports

**1. Ethernet LAN (RJ-45) port:** This port acts as a gateway to a wired network connection, allowing high-speed data transfer and internet access over the Ethernet cable.



**2. 2 eSATA ports:** These specialized connectors provide an external SATA interface, allowing for quick data transmission between the computer and external storage devices like hard drives.

**3. PS/2 port:** This legacy port connects the keyboard and mouse to the computer through a PS/2 connector. The keyboard port is purple and the Mouse port is green.



**4. VGA port:** The VGA port allows for analogue video output and is commonly used to link a computer to a monitor or projector, with video resolutions up to a particular level supported.



**5. 2 Headphone outputs:** These audio ports allow users to attach headphones and listen to audio output discreetly without bothering others.



**6. Microphone in:** This input allows users to connect external microphones, allowing them to capture audio recordings or communicate via voice.



**7. COM port (serial port):** The COM port allows for serial connection between the computer and different devices such as printers and scanners.



**8. 6 USB 2.0 ports:** These ports link USB 2.0 devices such as external hard drives, flash drives, and printers and provide moderate data transfer speeds.



### 3.2 Internal I/O Ports

**1. USB 2.0/1.1 connector:** This connection enables the expansion of two additional USB 2.0 or 1.1 ports, allowing for expanded connectivity.

**2. CPU fan connector:** This connector is used to connect the CPU fan to guarantee efficient cooling and temperature management for the processor when it is operating.

**3. Chassis fan connector:** Used to connect a chassis fan to the computer casing to maintain optimal airflow and heat dissipation.

**4. 18-bit LVDS connector:** This connector is used for connecting displays that use the Low Voltage Differential Signalling technology, which is commonly seen in laptops and some industrial applications.

**5. Front panel audio connector:** Connects the computer case's front panel audio jacks, allowing simple access to audio input and output.

**6. High-Definition front panel audio connector:** This, like the front panel audio connector, supports high-definition audio standards for better sound quality.

**7. 24-pin EATX power connector:** Delivers power from the computer's power supply unit to the motherboard, ensuring that the components function properly.

**8. 4-pin ATX 12V power connector:** Provides additional power to the CPU and other components, which is very useful in high-processing-demanding systems.

### 3.3 Speeds of I/O Ports

**1. RJ-45 port:** There are 3 main access speeds varying according to the used cable. 10Mbps, 100Mbps and 10Gbps.

2. PS/2 port: 7-12 kbps

3. COM port: 9.6 kbps

4. USB 2.0 port: 480Mbps

5. eSATA port: 600Mbps

## 4 Interface Standards

Interface Standard

CPUs come in sockets, primarily classed under Intel and AMD. However, the AT4NM10T-I motherboard offers a different approach by integrating the CPU directly onto the motherboard through soldering, avoiding the need for a socket. To verify compatibility in other

motherboards, it's customary to compare the CPU's contacts or pin count with the motherboard socket.

AT4NM10T-I motherboards typically incorporate DDR3 memory modules. These modules are commonly put in SO-DIMM slots, one of the most prevalent slot types. It can be added multiple quantities of RAM cards, ranging from 512MB to 2GB. The max memory of capable for this motherboard is 4GB.

SATA connections have succeeded IDE slots for hard drives. SATA3, with rates of up to 600MB/s. To connect a hard drive, one only needs to link it to the SATA port and supply power. Additionally, certain motherboards enable the M.2 interface for SSD hard drives, allowing significantly faster data transfer speeds.

Graphics card interfaces have included options like ISA, AGP, and PCI-e. The AT4NM10T-I motherboard supports the PCI graphic card interface. It is a 32 bit wide bus that runs at 33 MHz, offering a bandwidth of 133 MB/s. The PCI interface supplanted ISA and its extensions. Typically, graphics cards have VGA, DVI, or HDMI interfaces to connect to your monitor, enabling visual output.

The display interface is what ties a graphics card to the monitor. AT4NM10T-I motherboards include VGA port only for share visuals. There are 3 rows, 15 pin holes to share data. Refresh rate is limited to 60Hz & 70 Hz. Some motherboards also come equipped with integrated graphics cards that offer monitor ports, simplifying the setup process.

The I/O interface covers a range of connections needed for peripheral devices and connectivity. Two PS/2 ports are commonly provided for older mouse and keyboards, but USB interfaces are the go-to for new devices. For visual output, AT4NM10T-I has VGA ports only. The RJ-45 interface permits network connections, while audio interfaces, generally color-coded (blue for audio input and green for audio output), support sound devices



## 5. Memory Specifications & Connection with the Processor

Type of Memory	Specifications	Connection with the Processor
Random Access Memory	<ul style="list-style-type: none"> <li>• Non- ECC DDR3 800MHz memory modules (includes 2 x 204-pin SO-DIMM sockets)</li> <li>• Supports up to 2GB of memory modules for each socket</li> </ul>	<ul style="list-style-type: none"> <li>• Ram communicates with the CPU through a memory controller which is embedded in the CPU.</li> <li>• Ram is Connected to the memory controller through a memory bus, which includes separate address, data and control buses.</li> <li>• Memory controller in the CPU will decide the functioning rate(MHz) of the RAM. Every memory controller has a maximum data rate it can handle.</li> <li>• Memory controller is also responsible for continuously refreshing the RAM to ensure there is no data loss.</li> </ul>
Read Only Memory	<ul style="list-style-type: none"> <li>• EN25F80 chip is included as the ROM</li> <li>• 8 Mbit Serial Flash</li> <li>• 100Mhz Clock Rate</li> <li>• AMI BIOS included</li> </ul>	<ul style="list-style-type: none"> <li>• Rom is Connected to the memory controller through a memory bus, which includes separate address, data and control busses</li> </ul>
Cache	<ul style="list-style-type: none"> <li>• Primary 32-KB instruction cache and 24-KB write back cache</li> <li>• 512KB 8-way L2 Cache</li> </ul>	<ul style="list-style-type: none"> <li>• L1 and L2 caches are directly connected to the CPU unlike RAM.</li> </ul>
Registers	<ul style="list-style-type: none"> <li>• Varie from register to register</li> </ul>	<ul style="list-style-type: none"> <li>• Registers are internal memory locations inside the CPU which are directly connected to specific parts in the CPU.</li> </ul>
External Memory	<ul style="list-style-type: none"> <li>• Vary, independently from the motherboard</li> </ul>	<ul style="list-style-type: none"> <li>• This motherboard accommodates 4 serial ATA ports which supports AHCI mode to provide communication access to the external storages</li> <li>• Secondary memory is not accessed by the CPU directly. Data in the secondary memory is first uploaded to the Ram and then accessed by the CPU.</li> </ul>

## 6. Cooling System

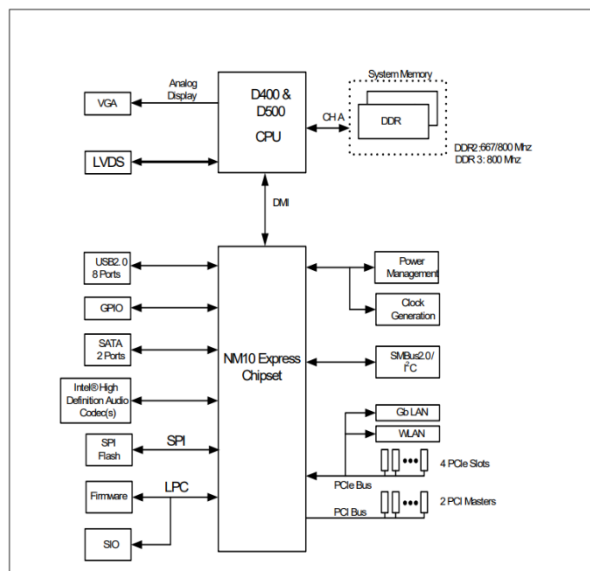
Keeping the CPU cool is critical. The CPU has the technology to reduce processor energy consumption (and heat) by turning off unused parts of the processor or slowing down the processor when it starts to overheat. But these measures alone are not enough. So the computer system uses the following cooling methods.

**6.1 Heat Sink:** A heat sink, made of metal like aluminium or copper, is put on the processor or other parts of the computer. It takes in and releases the heat made by the processor, and the air inside the computer case spreads the heat out, preventing it from getting too hot.

**6.2 Fan Cooling:** Fans are placed near or on the processor. They blow away the heat that builds up, making sure the processor doesn't get too hot. By moving air around, they help cool down both the processor and the whole computer.

**6.3 Liquid Cooling:** Liquid cooling is a way to keep the computer from getting too hot. Liquid moves through the heat sink. The heat from the processor goes into the liquid, and the liquid goes to a different part that releases the heat outside the computer. This keeps the processor's temperature steady, no matter how much it's used. Some liquid cooling systems need to be topped up with liquid now and then to work well over time

## 7. Functional Diagram



## 8. Task Allocation

Name	Task
R.N.Abeywardane	RAM, ROM, Network Adapter, Other ICs, Memory specifications, Functional block diagram
A.A.W.L.R.Amarasinghe	Motherboard Layout, I/O Ports, Cooling options
M.P.D.N.Wickramasingha	Processor, GPU, Battery ,Interface standards

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