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Motherboard Dissection

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EN2031 – Fundamentals of Computer Organization and Design

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Abstract

The motherboard is the central printed circuit board of a computer system, responsible for providing mechanical support, electrical connectivity, and communication pathways among all major hardware components. In modern laptop systems, motherboard designs are highly compact and integrate multiple subsystems in order to achieve reduced size, lower power consumption, and improved reliability. This report presents a detailed dissection and functional analysis of the motherboard used in the HP EliteBook 840 G3 laptop.

The analysis is based on physical inspection of the motherboard and focuses on identifying the major components and understanding their roles within the overall system architecture. Key components examined include the Intel 6th generation Core processor, integrated graphics processing unit, platform controller hub (chipset), memory modules, BIOS firmware, power management circuits, and input/output interfaces. The memory architecture, including RAM and non-volatile storage, is discussed along with the methods used to connect these components to the processor.

In addition, the report describes the various interface standards supported by the motherboard, such as USB, SATA, PCI Express, and DDR4 memory interfaces. The cooling system employed in the HP EliteBook 840 G3, consisting of a heat sink and fan-based thermal management solution, is also analyzed to explain how safe operating temperatures are maintained under normal workloads. Through this dissection, the report provides a comprehensive understanding of the internal organization, design considerations, and functional operation of a modern laptop motherboard.

1 Introduction

The motherboard acts as the backbone of a computer system, providing mechanical support, electrical connections, and communication pathways between internal components. In laptop systems, motherboard designs are highly compact and integrate multiple components to reduce size, weight, and power consumption.

The HP EliteBook 840 G3 is a business-class laptop designed for portability, reliability, and energy efficiency. Its motherboard integrates the processor, graphics unit, chipset, and power regulation circuits directly onto the PCB. This report documents the structure and operation of the HP EliteBook 840 G3 motherboard based on physical inspection.

2 Motherboard Layout

The HP EliteBook 840 G3 motherboard is an irregularly shaped, multi-layer printed circuit board designed to fit within a slim laptop chassis. Major regions include the CPU mounting area, memory slots, power regulation circuits, and peripheral connectors. The compact layout minimizes signal delays, improves power efficiency, and enhances thermal performance.

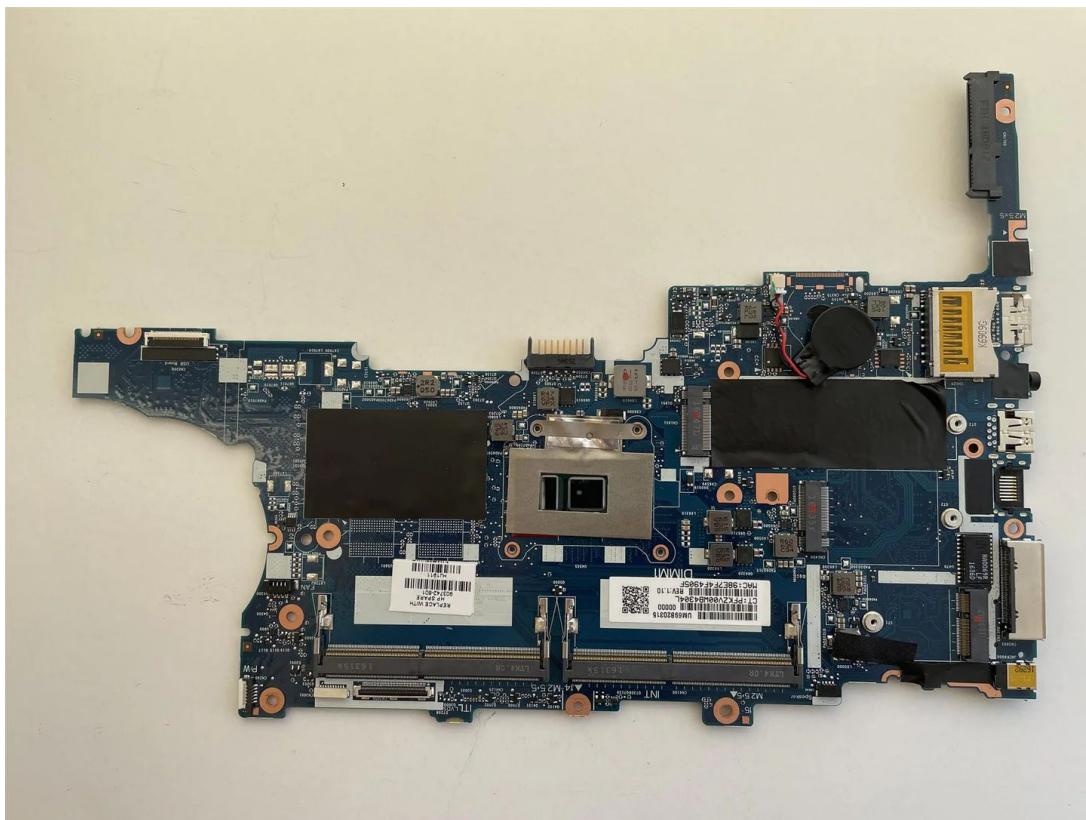


Figure 2.1: HP EliteBook 840 G3 Motherboard Layout-front view

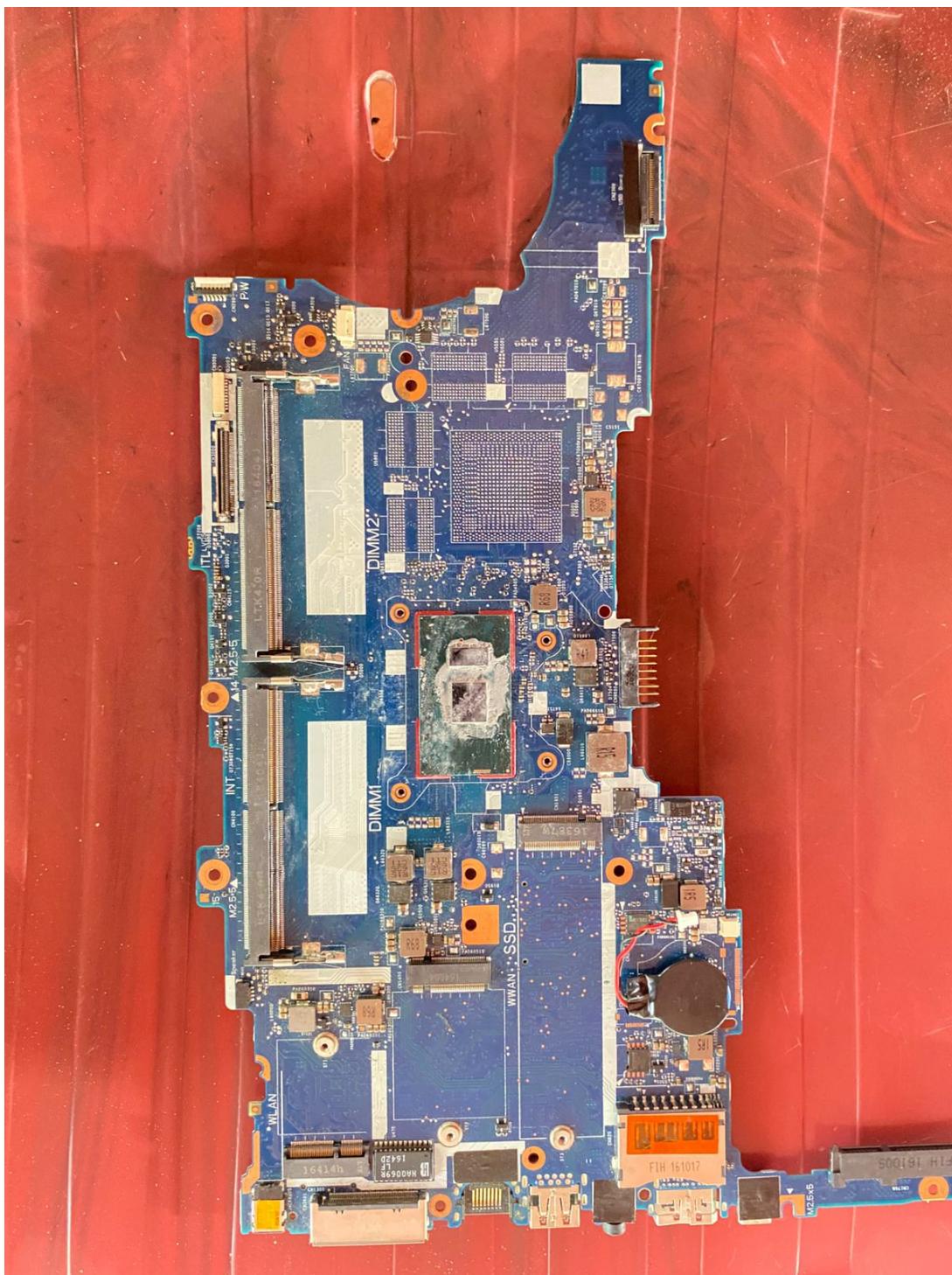


Figure 2.2: HP EliteBook 840 G3 Motherboard Layout-back view

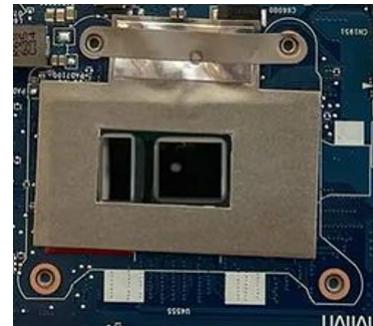


Figure 2.3: HP EliteBook 840 G3 Motherboard Layout-side view

3 Main Components

3.1 Processor (CPU)

The HP EliteBook 840 G3 uses an Intel 6th Generation Core processor based on the Skylake architecture. The processor is soldered directly onto the motherboard using a Ball Grid Array (BGA) package. This integration improves reliability, reduces size, and lowers power consumption.



Intel Core processor
(BGA package)

3.2 Chipset

The motherboard utilizes the Intel Sunrise Point-LP Platform Controller Hub (PCH). The chipset manages communication between the CPU and peripherals, including USB, SATA storage, audio, and network interfaces.



Intel Sunrise Point-LP
Platform Controller Hub

3.3 Memory Components

3.3.1 Random Access Memory (RAM)

The system supports DDR4 SDRAM using SO-DIMM modules. Two memory slots are available, supporting up to 32 GB of memory operating at 2133 MHz. RAM provides temporary storage for active programs and data.



DDR4 SO-DIMM memory
slots

3.3.2 Read Only Memory (ROM)

A serial flash memory chip stores the HP UEFI BIOS firmware. This non-volatile memory initializes system hardware and controls the boot process.



Serial flash memory chip containing UEFI BIOS

3.4 Graphics Processing Unit (GPU)

The motherboard uses Intel HD Graphics 520, which is integrated into the CPU. The integrated GPU supports high-definition video output and hardware-accelerated multimedia processing.

3.5 Network Interfaces

The system includes an integrated Ethernet controller and a wireless network module supporting Wi-Fi and Bluetooth connectivity.

3.6 Audio Controller

A High Definition Audio (HDA) codec is used to provide microphone input and headphone output, supporting standard audio playback and recording.



Audio interface and high-definition audio codec

3.7 Power Management Circuits

Multiple voltage regulation modules (VRMs) and power management ICs regulate and distribute power to the CPU, memory, and peripheral devices.



Power management ICs
and voltage regulator
modules

3.8 CMOS Battery

A coin-cell CMOS battery is used to retain system time, date, and BIOS configuration settings when the system is powered off.



CMOS battery for RTC
and BIOS configuration

4 Input and Output Ports

4.1 External I/O Ports

The HP EliteBook 840 G3 provides several external ports, including USB Type-A ports, a USB Type-C port, a 3.5 mm audio jack, Ethernet (RJ-45), and an SD card reader.



External I/O ports of the motherboard

4.2 Internal I/O Connectors

Internal connectors include SATA and M.2 interfaces for storage, keyboard and touchpad ribbon connectors, display connectors, and cooling fan connectors.

5 Interface Standards

The motherboard supports modern interface standards such as USB 3.0, USB Type-C, SATA III, PCI Express, DDR4 memory interfaces, and embedded DisplayPort (eDP) for display connectivity.

6 Memory Specifications & Connection with the Processor

Type of Memory	Specifications	Connection with the Processor
Random Access Memory (RAM)	<ul style="list-style-type: none"> • DDR4 SDRAM SO-DIMM modules • Operating frequency: 2133 MHz • Two SO-DIMM slots available • Supports up to 32 GB total memory 	<ul style="list-style-type: none"> • Communicates with the CPU through the integrated memory controller • Connected via a high-speed memory bus consisting of address, data, and control lines • Memory controller determines the operating frequency of RAM • Responsible for continuous memory refreshing
Read Only Memory (ROM)	<ul style="list-style-type: none"> • Serial flash memory chip • Stores HP UEFI BIOS firmware • Non-volatile memory 	<ul style="list-style-type: none"> • Connected to the CPU via SPI bus • Used during system initialization and boot process
Cache Memory	<ul style="list-style-type: none"> • L1 instruction and data cache • L2 cache • L3 shared cache 	<ul style="list-style-type: none"> • Integrated directly within the CPU • Provides high-speed data access compared to RAM

Type of Memory	Specifications	Connection with the Processor
Registers	<ul style="list-style-type: none"> Very small, high-speed memory locations Vary depending on processor architecture 	<ul style="list-style-type: none"> Located inside the CPU Directly connected to execution units
External Memory	<ul style="list-style-type: none"> SATA SSD / HDD NVMe SSD via M.2 interface 	<ul style="list-style-type: none"> Connected through SATA or PCI Express interfaces Data is transferred to RAM before CPU access

7 Cooling System

7.1 Heat Sink

A copper heat sink is mounted directly above the processor to absorb heat generated during operation.

7.2 Fan Cooling

A blower-type cooling fan forces air through the heat sink fins, dissipating heat efficiently and maintaining safe operating temperatures.

7.3 Thermal Design

The cooling system is designed to support sustained workloads while maintaining low noise and power consumption.

8 Functional Block Diagram

The CPU acts as the central processing unit and communicates with RAM through the integrated memory controller. The chipset interfaces with storage devices, USB ports, audio, and network controllers. Power management ICs supply regulated voltages, and the BIOS initializes the system during startup.

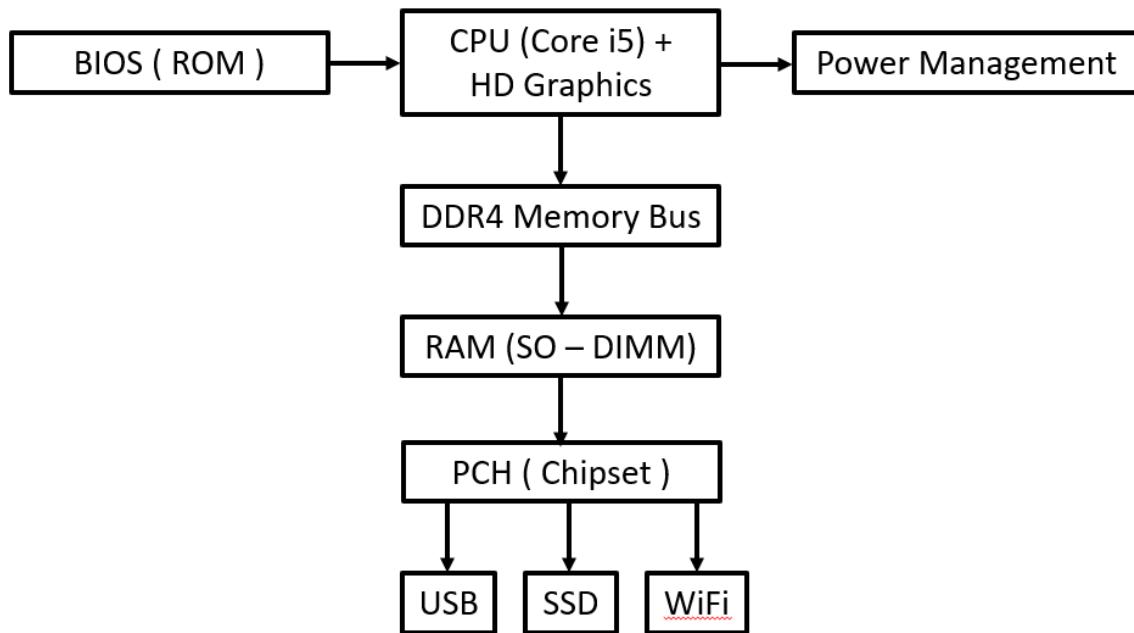


Figure 8.1: Functional block diagram of HP EliteBook 840 G3 motherboard

9 Conclusion

The HP EliteBook 840 G3 motherboard demonstrates a compact and efficient laptop motherboard design. Integration of the processor, chipset, and graphics unit enables low power consumption and reliable performance. The system is optimized for business applications requiring portability and stability.

References

- Intel 6th Generation Core Processor Datasheets
- HP EliteBook 840 G3 Maintenance and Service Guide
- Intel Platform Controller Hub Documentation
- <https://www.intel.com>
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