COMPUTING TECHNOLOGY

Comprehensive Technical Analysis of the GEEKOM Mini IT8 Series: Architecture, Performance, and Industrial Application

Published: June 20, 2025 | Index ID: #746

The Paradigm Shift Toward High-Density Mini Computing

In the contemporary landscape of computing, the demand for high-performance hardware within a reduced physical footprint has led to the proliferation of Small Form Factor (SFF) devices. The **GEEKOM Mini IT8 series**, featuring both Intel Core i3-8109U and i5-8259U variants, represents a significant engineering milestone in the evolution of the NUC (Next Unit of Computing) standard. These devices are designed to bridge the gap between traditional bulky desktop workstations and low-power mobile devices, offering a robust balance of thermal efficiency, computational throughput, and peripheral versatility.

Technical professionals, ranging from IT administrators to software developers, increasingly look toward the GEEKOM Mini IT8 as a solution for diverse environments, including digital signage, home laboratory virtualization, and high-production office workstations. This analysis provides an in-depth exploration of the underlying **Coffee Lake-U microarchitecture**, the engineering of the thermal management systems, and the strategic advantages of the 8th Generation Intel silicon in a compact 117 x 112 x 46 mm chassis.

Core Architectural Framework: Intel Coffee Lake-U

The GEEKOM Mini IT8 is powered by the **Intel 8th Generation Coffee Lake-U** series processors. Unlike the standard mobile processors of previous generations, these chips utilize the 14nm++ process node, which allows for higher clock speeds and improved power efficiency. The two primary configurations observed in the IT8 lineup involve the **Core i3-8109U** and the **Core i5-8259U**.

The Core i5-8259U is a quad-core processor with eight threads, supporting Intel Hyper-Threading technology. It operates at a base frequency of 2.30 GHz with a maximum turbo frequency of 3.80 GHz. A critical differentiator for this specific silicon is its **28W Thermal Design Power (TDP)**, which is significantly higher than the standard 15W found in typical Ultrabook processors. This increased TDP allow the processor to maintain higher sustain frequencies under load, making it particularly suitable for intensive computational tasks like video transcoding or complex spreadsheet modeling.

The Core i3-8109U variant, while featuring only two cores and four threads, remains a formidable competitor in the entry-to-mid-range market. It shares the 28W TDP envelope and includes **Intel Iris Plus Graphics 655**, featuring 128MB of integrated eDRAM. This embedded DRAM acts as a high-speed cache for the GPU, drastically reducing the latency associated with fetching data from system memory (DDR4), thereby enhancing graphical performance beyond what is typically expected from integrated solutions.

Memory and Storage Hierarchy

Data throughput and latency are governed by the IT8's sophisticated memory and storage architecture. The device supports **Dual-channel DDR4-2400 SO-DIMM RAM**, allowing for a maximum capacity of 32GB (some configurations may support up to 64GB depending on the firmware version). The use of dual-channel architecture is essential for maximizing the bandwidth of the Iris Plus Graphics, as integrated GPUs are heavily dependent on

system memory speed.

Storage options are categorized into high-speed NVMe and bulk SATA tiers:

- M.2 2280 Slot: Supports PCIe Gen3 x4 NVMe SSDs, providing read/write speeds that can exceed 3,500 MB/s, essential for rapid OS boot times and application loading.
- SATA 2.5-inch Bay: Includes a dedicated slot for a 7mm HDD or SSD, enabling massive storage expansion up to 2TB for media libraries or local database backups.

Technical Specifications Comparison Matrix

To better understand the performance delta between the available models, the following table illustrates the core technical differences within the GEEKOM Mini IT8 ecosystem.

Feature	Intel Core i3-8109U Model	Intel Core i5-8259U Model
Cores / Threads	2 Cores / 4 Threads	4 Cores / 8 Threads
Base / Turbo Frequency	3.00 GHz / 3.60 GHz	2.30 GHz / 3.80 GHz
Cache	4 MB Intel Smart Cache	6 MB Intel Smart Cache
Graphics	Intel Iris Plus Graphics 655	Intel Iris Plus Graphics 655
TDP (Configurable)	28 Watts	28 Watts
Max RAM Support	32GB DDR4-2400	32GB DDR4-2400
eDRAM	128 MB	128 MB

Engineering and Thermal Management Systems

One of the primary challenges in SFF design is **thermal throttling**. When a 28W TDP processor is placed in a chassis with a volume of less than one liter, heat dissipation becomes the limiting factor for performance. GEEKOM addresses this through a high-efficiency centrifugal fan coupled with a copper heat pipe assembly.

The cooling system operates on an active modulation principle. Sensors on the Motherboard (PCH) and the CPU die monitor real-time temperatures. The **BIOS-level fan curve**is tuned to maintain a balance between acoustic comfort and component longevity. Under idle conditions, the fan operates at low RPMs (approx. 30-35 dB), but under full load during stress tests (such as Prime95 or Cinebench R23), the fan ramps up to evacuate heat through the rear and side vents. This prevents the CPU from exceeding its T-junction temperature of 100°C, ensuring that the system does not throttle its clock speed during critical operations.

Graphics and Visual Output Capabilities

The inclusion of **Intel Iris Plus Graphics 655**elevates the GEEKOM Mini IT8 above standard office PCs. This GPU supports 4K resolution at 60Hz across multiple displays. The hardware-level support for HEVC (H.265) and VP9 hardware acceleration allows for seamless streaming of high-bitrate video content without taxing the CPU cores.

I/O Connectivity and Peripheral Integration

A Mini PC's utility is often defined by its connectivity. The Mini IT8 provides a dense array of ports that rival full-sized desktop towers:

- USB 3.2 Gen 2: Multiple ports offering up to 10Gbps transfer speeds for external NVMe enclosures and high-speed peripherals.
- USB-C (Data and Video): Supports DP Alt Mode, allowing for a single-cable connection to modern monitors.
- HDMI 2.0 and Mini DisplayPort: Enables multi-monitor setups, essential for financial trading, software development, or creative workflows.
- Gigabit Ethernet (RJ45): Provides stable, low-latency networking for NAS connectivity and remote management.
- SD Card Reader: A built-in full-sized SDXC slot (UHS-I) for photographers and content creators.

Step-by-Step Procedure: Optimizing the GEEKOM Mini IT8 for Professional Use

To maximize the efficiency of the device, users should follow this technical optimization workflow:

1. Memory Configuration: Always populate both SO-DIMM slots with matching modules to enable Dual-Channel mode. This increases memory bandwidth by nearly 100%, which is critical for the Iris Plus GPU performance.
2. BIOS Tuning: Access the BIOS (typically via the F2 or Del key) to adjust the Power Limit (PL1 and PL2) settings if sustained high-performance is required. Ensure that the 'Fast Boot' option is enabled to minimize UEFI initialization time.
3. Driver Management: Install the Intel Driver & Support Assistant (DSA). Unlike standard laptops, the IT8 relies on specific Intel Management Engine (ME) and Serial I/O drivers to handle the unique I/O mapping of the Coffee Lake chipset.
4. Thermal Optimization: For industrial deployments, it is recommended to replace the stock thermal interface material (TIM) with a high-conductivity silver or ceramic-based paste after the warranty period to reduce operating temperatures by 3-5°C.

Case Study: Homelab Virtualization Performance

The GEEKOM Mini IT8 has gained popularity in the "HomeLab" community as a node for **Proxmox VE** or **VMware ESXi**. In a controlled test environment, an IT8 with 32GB of RAM and a 1TB NVMe SSD was capable of running seven concurrent Linux containers (LXC) and three Windows Server Virtual Machines (VMs) without significant IO-wait or CPU contention.

The key to this success lies in the **Intel VT-x and VT-d** virtualization technologies embedded in the 8th Gen silicon. These features allow for hardware-accelerated virtualization and direct passthrough of PCIe devices (like the NIC or GPU) to guest operating systems, minimizing the overhead typically associated with software-defined virtualization.

Common Troubleshooting and Operational Solutions

While the GEEKOM Mini IT8 is engineered for reliability, certain operational challenges may arise in specific environments:

Issue	Probable Cause	Technical Solution
System Overheating / Throttling	Dust accumulation in the cooling fins or blocked air intakes.	Use compressed air to clear the side intake vents and rear exhaust. Check fan RPM in BIOS.
No Display Output via USB-C	Incompatible cable or lack of DP Alt Mode support on the monitor.	Ensure the use of a USB 3.2 Gen 2 cable rated for 10Gbps and video transmission. Update Intel Graphics Command Center.
Slow NVMe Performance	SSD running in PCIe Gen3 x2 mode or thermal throttling of the drive.	Confirm the drive is seated correctly in the M.2 slot. Check for NVMe firmware updates from the manufacturer.
Boot Device Not Found	UEFI/Legacy boot mode mismatch in BIOS.	Switch the BIOS Boot Mode to 'UEFI Only' for modern Windows 10/11 or Linux distributions.

The Future of the GEEKOM Ecosystem

The GEEKOM Mini IT8 stands as a testament to the longevity of Intel’s 14nm architecture. While newer 10nm and 7nm chips offer improved efficiency per watt, the 28W Coffee Lake-U silicon remains highly competitive for general-purpose computing due to its high clock ceilings and excellent driver stability. In an era where energy costs and workspace efficiency are paramount, the Mini IT8 provides a compelling argument for the decentralization of computing power.

By integrating high-speed NVMe storage, dual-channel DDR4 memory, and a comprehensive suite of I/O options into a palm-sized chassis, GEEKOM has created a versatile tool for the modern professional. Whether it is utilized as a high-performance office PC, a quiet HTPC for 4K media consumption, or a rugged node for edge computing in industrial settings, the IT8 series delivers the reliability and performance required by technical users worldwide. The engineering balance found in this device—prioritizing I/O density and thermal stability—sets a high standard for the sub-500ml computing category, ensuring its relevance in the market for years to come.

Tags: #Geekom Mini IT8 #Intel Coffee Lake #Mini PC Review #Small Form Factor Computing #Intel Core i5 8259U #PC Hardware Analysis