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i7-8705G Processor Review/Analysis

**Section I**

The i7-8705G processor, developed by Intel, was released in January of 2018, and was designed with the idea of providing a thin and light machine capable of high performance by supporting more than **integrated graphics** through the introduction of for **discrete graphics** with Radeon RX Vega M GL. It is an 8th Generation Intel Core i7 processor manufactured in 14 nm **lithography**. The CPU provides 4 **cores** and 8 **threads** with a **base processor frequency** of 3.10 GHz and a **max turbo frequency** of 4.10 GHz. The **cache** supports 8 MB of fast memory and **bus speeds** are processed at 8 GT/s. The processor requires 65W of power requiring a chassis that can dissipate the heat efficiently. The processor also supports a maximum of 64 GB in **memory** of type DDR4-2400 with a maximum of 2 **memory channels** and a maximum of 37.5 GB/s in **memory bandwidth** with no **ECC memory** support. The processor supports a BGA2270 socket and its dimensions are 31mm by 58.5mm. It uses a 64-bit **instruction set** with a maximum operating temperature at 100 degree Celsius.

The integrated processor graphics use Intel HD Graphics 630 that comes with 4 GB of **HBM2** and provides a base frequency of 350 MHz and a **max dynamic frequency** of 1.10 GHz. The integrated graphics has a **max video memory** of 64 GB and also provides 4K support. However, the discrete graphics use Radeon RX Vega M GL Graphics and have a base frequency of 931 MHz and a max dynamic frequency of 1011 MHz. While the discrete graphics also support 4K, they also provide 20 **compute units** and a memorybandwidth of 179.2 GB/s giving it a better performance for games than the integrated graphics.

Based on the specifications of this processor and the varying levels of performance it offers through integrated and discrete graphics, this processor allows for advanced content creation at 4K and entry level gaming or even competitive gaming. The processor is designed to do a little bit of everything, but not one thing exceedingly well. It is intended to be marketed towards students or people who prefer to have a portable thin and light notebook/device and might require content creation in 4K or even entry level gaming.

**Section II**

The Intel i7-8705G processor uses parts from Kaby Lake H combined with an AMD Vega GPU to form the Kaby Lake G **microarchitecture** using the x86 **ISA**. Processors using the Kaby Lake G microarchitecture use a two-chip solution of the microprocessor and the chipset. The two chips use ball grid arrays to provide more interconnection pins and are then soldered onto the motherboard. To allow for an 8 GT/s transfer rate per lane the microprocessor uses 4 out of the chip’s 20 **PCIe lanes** to connect to the chipset. The microprocessor is also connected to the GPU through 8 of the other PCIe lanes reserved strictly for GPU and CPU communication, with the remaining 8 PCIe lanes for peripherals with direct access to the CPU. The 4GB of HBM2 is interconnected with the GPU using an embedded multi-die interconnect bridge – which is a cost-effective approach to the interconnection of the two chips. Moreover, the use of HBM2 results in 80% less power and that power saving becomes significant by reverting to the integrated graphics from the discrete graphics when high performance is not of importance. By using HBM2 has also resulted in about 3 square inches of extra board space instead of opting for GDDR5, allowing for a denser packaging for the thin and light notebooks. Kaby Lake G also introduced **Dynamic Tuning** which allows for the power consumption of the GPU and CPU to be adjusted depending on the application, further making it possible to build such a processor. This allows the CPU to accelerate on applications while the discrete GPU is not being used, and it allows the GPU to be accelerated while the person is gaming or creating content making it an efficient processor.

The overall memory structure of the Kaby Lake G microarchitecture is similar to its predecessor, Skylake. The **cache organization** dedicates 256 KiB at L1 where the L1I cache has 128 KiB with 8-way set associative shared by the two threads per core. The L1D cache also has 128 KiB with 8-way set associative shared by the two threads per core, however the L1D differentiates with the L1I since it has write-back policy. The L2 cache has a unified 1 MiB of 4-way set associative with 12 cycles for fastest load-to-use and is non-inclusive with write-back policy. The L3 cache has 8 MiB of 16-way set associative which is inclusive and a write-back policy. The L3 cache also has read and write speeds of 32 B/cycle and it allows for 42 cycles for the fastest load-to-use.

**Section III**

**Review 1: Techspot** <https://www.techspot.com/review/1654-intel-kaby-lake-g/>

The Kaby Lake G microarchitecture is “one of the most unexpected and interesting pieces of hardware to come from Intel in a while.” The chip combines an Intel CPU and an AMD GPU making “essentially the fastest APU-style processor” on the market, however it is not exactly an “APU or SoC”. The 65W models of the Kaby Lake G microarchitecture will most likely be used in laptops which consider the Kaby Lake G microarchitecture due to requiring less power than the 100W models. The 65W model uses the Vega M GL graphics which results in 20 less CUs and also lowers the clock speeds from 931 to 1011 MHz. The availability of having integrated graphic sand discrete graphics allows for the integrated graphics to be used when superior graphics performance is not required. The power split difference between the CPU and GPU results in the CPU being capped to 47W and gives the GPU 18W to work. However, in practicality the GPU will run above 18W and the CPU below 47W.

**Review 2: Laptoping** <https://laptoping.com/cpus/product/intel-core-i7-8705g/>

The i7-8705G is high-end laptop processor. The additionally built feature of the Radeon RX Vega M GL graphics processor allows for much better gaming and graphics compared to the Intel HD 630 processor. In benchmarks “against the most popular laptop processors,” the i7-8705G, the performance is near the top of the list, only behind the i7-8750H, i7-8850H, and the i9-8950HK. As a result the processor is suited for demanding resource intensive tasks. However, compared to other notebook CPUs, the “i7-8705G consumes more power”, but to keep in mind that the “65 Watts of the i7-8750G includes power consumption of the Radeon graphics.” Taking that into consideration, it is seen that the processor is power and energy efficient. Based on the specifications of the product, it is best typically used for gaming and high-performance laptops.

**Review 3: Eurogamer** <https://www.eurogamer.net/articles/digitalfoundry-2018-core-i7-g-with-radeon-rx-vega-spec-analysis>

The i7 G products are an “unprecedented collaboration” between Intel and AMD. The i7-8705G processor uses a ball grid array set-up which means the chips are soldered onto the motherboards. Although the eighth generation of the Kaby Lake, the bandwidth on all processors is still limited to 2400 MHz, the same as the seventh generation Kaby Lake. With the i7-8705G, the CPU is fairly well known, however the Radeon RX Vega aspect is “fascinating”. For the i7-8705G the CU count is 20 and throughput is 2.6 teraflops. The i7-8705G only requires 65W and Intel states that the models are 10 to 40 percent faster compared to a standard “i7-7700HQ paired with a GTX 1050.” The performance and cost-effectiveness is praised, however it is not yet known how “Intel has achieved this miracle” except for the dynamic power management system, but “lacks detail” on how it is actually achieved. The Intel processor does offer something “new and exciting” with the Radeon graphic, but it also means that a premium price should be expected to accommodate the features.

**Section IV**

* Integrated graphics – graphics built into the motherboard at the silicon lvel
* Discrete graphics – graphics that are more powerful in nature connect to a motherboard using a PCIe
* Lithography – the semiconductor technology used to manufacture an integrated circuit
* Cores – a hardware term that describes the number of independent CPUs in a single computing component
* Threads – software term for the basic ordered sequence of instructions that can be processed by a single CPU core
* Base Processor Frequency – the rate at which the processor’s transistors open and close and is the operating point where the thermal design power (TDP) is defined
* Max Turbo Frequency – the maximum single core frequency at which the processor is capable of operating
* Cache – an area of fast memory located on the processor
* Bus Speeds – a subsystem that transfers data between computer components or between computers
* Memory – any physical device capable of soring information temporarily such as RAM
* Memory Channels – the bandwidth operation for real world application
* Memory Bandwidth – the maximum rate at which data can be read from or stored into a semiconductor memory by the processor
* ECC Memory – indicates processor support for Error-Correcting Code memory which is a type of system memory that can detect and correct common kinds of internal data corruption
* Instruction Set – the basic set of commands and instruction that a microprocessor understands and can carry out
* HBM2 - High Bandwidth Memory Second Generation is a high-performance RAM interface for use in conjunction with high-performance graphics
* Max Dynamic Frequency – the maximum opportunistic graphics render clock frequency that can be supported
* Max Video Memory – maximum amount of memory accessible to process graphics
* Compute Units – a stream multiprocessor that does computing
* Microarchitecture – used to describe resources and methods used to achieve architecture specification
* ISA – instruction set architecture
* PCIe Lanes – peripheral component interconnect express, one or more data-transmission lanes connected serially.
* Dynamic Tuning – set of software and drivers that performs more fine-tuning power allocations between the GPU and CPU dynamically in order to provide the best power allocation based on the user workload.
* Cache Organization – the organization of the different levels of cache memory

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