Intel Compute Stick
Overview

- Product Summary
- Design
- General Specifications
- Processor Specifications
- Graphics Features
- Audio
- Storage
- Memory
- Peripherals
- Wireless Connection
- Price Drivers
Product Summary

- Fully Functional PC
- Plugs into HDMI port
- Windows or Linux OS
- 32 GB Storage
- 1 or 2 GB RAM
- Peripheral Ports
- Bluetooth & Wi-Fi
Design

• Compact
• Passive Cooling System
• External Power Supply

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Stats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length:</td>
<td>4.07”</td>
</tr>
<tr>
<td>Width:</td>
<td>1.48”</td>
</tr>
<tr>
<td>Thickness:</td>
<td>0.49”</td>
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</tbody>
</table>
# General Specifications

<table>
<thead>
<tr>
<th>Computer Component</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor:</td>
<td>Intel Atom Z3735F</td>
</tr>
<tr>
<td>Graphics:</td>
<td>Integrated (Intel HD Graphics Technology)</td>
</tr>
<tr>
<td>Audio:</td>
<td>Intel High Definition (Intel HD) Audio via HDMI v1.4a Interface</td>
</tr>
<tr>
<td>Storage:</td>
<td>32GB (eMMC)</td>
</tr>
<tr>
<td>RAM:</td>
<td>2GB Single-Channel DDR3L/L-RS 1.35V 1333 MHz</td>
</tr>
<tr>
<td>Peripheral Interface:</td>
<td>1 Full Size USB 2.0 Port</td>
</tr>
<tr>
<td>Operating System:</td>
<td>Windows</td>
</tr>
<tr>
<td>Wireless LAN:</td>
<td>Single Band Wireless-N module 802.11g/n, Single Band, 1x1 Wi-Fi + Bluetooth 4.0</td>
</tr>
</tbody>
</table>
Processor - Overview

- Intel Atom Z3735F
- Released early 2014
- System-on-chip (SoC)
- Integrated graphics and memory controller
- Quad out-of-order execution (OOE)
## Specifications

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instruction Set:</strong></td>
<td>64 bit</td>
</tr>
<tr>
<td><strong>Processor Cores:</strong></td>
<td>4</td>
</tr>
<tr>
<td><strong>Threads:</strong></td>
<td>4</td>
</tr>
<tr>
<td><strong>Base Frequency:</strong></td>
<td>1.33GHz</td>
</tr>
<tr>
<td><strong>Burst Frequency:</strong></td>
<td>1.83 GHz</td>
</tr>
<tr>
<td><strong>Graphics Frequency:</strong></td>
<td>311MHz</td>
</tr>
<tr>
<td><strong>Graphics Burst Frequency:</strong></td>
<td>646MHz</td>
</tr>
<tr>
<td><strong>Max Memory:</strong></td>
<td>2GB DDR3L-RS 1333</td>
</tr>
<tr>
<td><strong>Memory Channels:</strong></td>
<td>Single Channel</td>
</tr>
<tr>
<td><strong>Memory Bandwidth:</strong></td>
<td>10.6 GB/s</td>
</tr>
<tr>
<td><strong>L2 Cache:</strong></td>
<td>2MB</td>
</tr>
</tbody>
</table>
Processor - Burst Technology

- Intel Burst Power Technology (BPT) vs. Boost Technology
- Thermal Design Power Limit (TDP)
- Frequency determined by number of operating cores, core consumption, power consumption, temperature
- Processor tends to run at max power for long periods of time as opposed to running only a few seconds at a time
- Feature available only when processor state is C0
Processor Instructions

- Advanced Encryption Standard New Instructions (AES-NI): set of SIMD instructions for encryption, decryption, authentication, and random number generation
- Consists of 6 instructions all aimed at creating a faster more secure performance
- Why is this instruction set helpful?
Bay Trail is processor family part of Intel Silvermont microarchitecture SoC design
• A number of Bay Trail Processors come with 4GB DDR3 SDRAM and dual channel memory (4K capability)
• Integrated graphics @ 311 MHz, 646MHz (Burst)
• Maximum of 1080p @60 fps decoding
• Maximum of 1080p@30 fps encoding
• Dynamic Video Memory Technology (DVMT, System memory allocated for graphic processing when needed, 64MB default, 512MB maximum)
3D Graphics

• 4 Execution units working concurrently at 32 bits each per cycle (128 total)
• 6 stage pipeline for processing 3D graphics
• SIMD 8 (eight 16-bit short integers) instructions for vertex processing
• SIMD 16 (sixteen 8-bit bytes or characters) for pixel processing
Bay Trail
Intel® HD Graphics

Video
- Full hardware acceleration support for h.264, VC-1, MPEG -2
- Dedicated fixed hardware pipeline for encode decode
- Includes VX392 video decode core (low power high performance, VP8)
- HDMI 1.4a (4k & Ultra HD support)
  - Maximum 4096 x 2160 resolution @ 24Hz
  - Capable of 1080p 3D video @ 24Hz
- DirectX 11, OpenCL 1.1, OGL ES2.0, OpenGL 3.0 , API support for 3D graphics
Audio

- AC3 - Dolby Digital (Audio Codec 3)
  - 5.1 Channels Maximum (Mono & Stereo mode support)
  - 5 Channels (20 – 20,000 Hz)
  - 1 Channel (20 – 120 Hz, Subwoofer)
  - Maximum 640 Kb/s bit rate
- E-AC3 Dolby Digital Plus (Enhanced Audio Codec 3)
  - 15.1 Channels Maximum
  - 7.1 Channels Maximum (HD DVD & Blue Ray Format)
  - Maximum 6.144 Mb/s bit rate
- LPCM (Linear Pulse Code Modulation)
  - 192 kHz / 24-bit,
  - 8 Channel (7.1 surround)
Storage

- 32 GB maximum capacity
- eMMC 4.5 – Embedded Multi Media Card
  - Embedded non volatile flash memory
  - Memory controller built into eMMC as opposed managed by CPU
  - Mounted on Ball Grid Array on PCB (permanent)
  - Newest standards of eMMC, (eMMC 5.1) capable of speeds up to 400 MB/s
eMMC 4.5 Controller

• Supports 1, 4, and 8 bit data transfers
• Operates at a maximum 200 MHz 1.6 Gb/s bandwidth (4.5 controller only)
• Baseline 25 MHz (200 Mb/s bandwidth max)
• eMMC functions: extended partitioning, data tags, context IDs
• Supports instruction for controller to enter power sleep mode at host system’s designation
• Customizable for SoC specific design
Memory

- 2GB Micron DDR3L/L-RS SDRAM (Double Data Rate Type 3 Low Voltage (1.35v) Synchronous Dynamic Random Access Memory)
  - RS (Reduced Standby), cuts power used by system on standby mode by 25%
  - RS backwards compatible with DDR3 standard
  - Operates at 1333 MHz capable of 10.6 GB/s transfer rate
- Single Channel operation
  - One data pathway between Ram and memory controller (64 bit channel)
### Peripherals - Ports

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Security cable opening</td>
</tr>
<tr>
<td><img src="usb.png" alt="USB" /></td>
<td>USB 2.0 port</td>
</tr>
<tr>
<td><img src="5vdc.png" alt="5V DC" /></td>
<td>Power connector</td>
</tr>
<tr>
<td><img src="power.png" alt="Power" /></td>
<td>Power button</td>
</tr>
</tbody>
</table>
## Peripherals - Ports

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDMI</td>
<td>HDMI connector</td>
</tr>
<tr>
<td>Micro SD</td>
<td>Micro SD memory card slot</td>
</tr>
<tr>
<td>Power LED</td>
<td>Power LED—blue</td>
</tr>
</tbody>
</table>
Peripherals - Connection and Powering

Plug it directly into a HDMI port on a television or monitor.

Use AC adapter to power.
Peripherals - Powering (USB)

It is designed to use up to 10 W of power.

A television’s USB port can be used as a power supply
• A USB 2.0 port normally supplies 2.5 W of power.

To use the USB port:
• Plug the micro-USB end of the 3-foot USB cable into the Intel Compute Stick.
• Plug the standard USB end of the cable into the USB port on the TV or monitor.
Peripherals - USB

The CPU supports USB 3.0, but Intel used 1 USB 2.0 port.

- USB 3.0 provides 900mA.
- USB 2.0 has a maximum current of 500 mA.

It seems that Intel chose USB 2.0 due to considerations of power usage.

Uses xHCI (eXtensible Host Controller Interface) as USB Controller.

- xHCI supports Super Speed for USB 3.0, but for USB 2.0, Full Speed is fastest.
Peripherals - Wireless

Intel’s Baytrail does not have wireless chipset integrated.

Wireless chipset is a Subsystem (not on chip).

Single Band Wireless module supports
• 802.11g/n, Single Band, 1x1
• Bluetooth 4.0
Peripherals - Power management

Software support:

Advanced Configuration and Power Interface (ACPI) [Next Slide]

Hardware support:

Power Input (Intel Compute Stick)

- Has some power states (Global state, Sleeping state, Processor state, Device state)

Instantly Available PC technology

- Set power state to S4 (ACPI - State, Suspend to Disk)
Peripherals - ACPI

Advanced Configuration and Power Interface (ACPI) is an open industry specification
Co-developed by Hewlett-Packard, Intel, Microsoft, Phoenix, and Toshiba.

Establishes industry-standard interfaces enabling OS-directed configuration, power management,
and thermal management of mobile, desktop, and server platforms.

- More costly, but more effective than APM (Advanced Power Management).
- Individual applications don't need to manage power.
- Device driver uses ACPI to interface with hardware power management.
- ACPI is abstract, which allows the OS to evolve separate from the hardware.
- The power management state machine is handled by the OS.
Peripherals – ACPI (Continued)

ACPI gives the operating system direct control over the power management and Plug and Play.

Intel Compute Stick requires an operating system that provides full ACPI support.

ACPI features include:

- Plug and Play (including bus and device enumeration)
- Power management control of individual devices
Price Driving Factors

Tray (Standalone) Intel Atom Z: $17.00
eMMC 16Gb: $5.50
DDR3L/L-RS 1.35V 1333MHz: $1.50
Wireless N Module: $23.00

Total: $47.00

Retail of Intel Compute Stick: $84.99 (Linux), $109.99/$114.99 (Windows)
References


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