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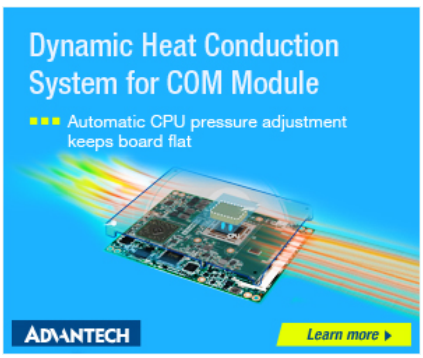


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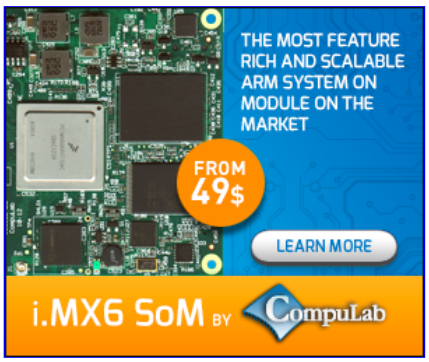
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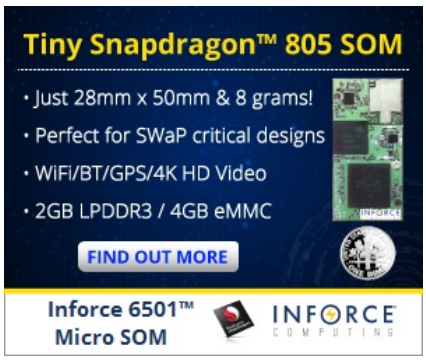
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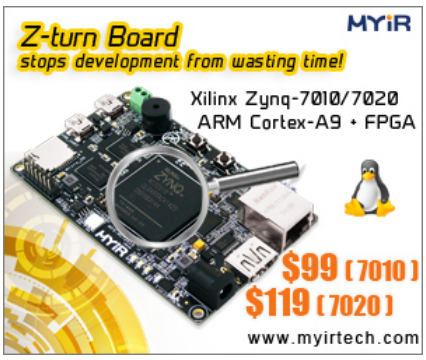

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Intel unveils tiny $99 MinnowBoard Max open SBC

Mar 31, 2014 by Eric Brown — 72,116 views

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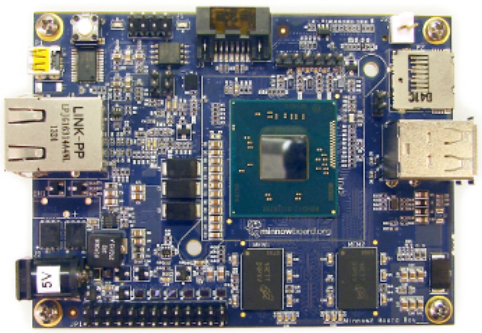
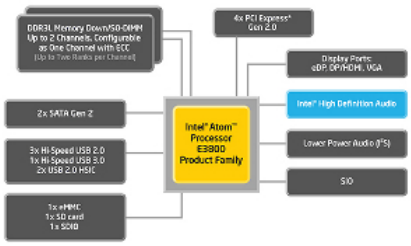
[Updated Jul 31] — Intel and CircuitCo revealed a smaller, faster, second-gen MinnowBoard SBC featuring an Atom E3800 SoC, revised I/O, and both Android 4.4 and Linux support.

Intel announced its open source MinnowBoard in April 2013 and shipped it for $199 in July. Built by CircuitCo and backed by Intel's Minnowboard.org community, the Linux-ready single board computer is now available for $189. The new MinnowBoard Max, due early in the third quarter, blows past the original on price, performance, and energy consumption, while shrinking size from 4.2 x 4.2 inches to 3.9 x 2.9 inches.



MinnowBoard Max
(click image to enlarge)

The updated SBC's Atom E3800 (Bay Trail-I) is faster than the earlier Atom E640 processor, offers better graphics, and provides lower power consumption. Unlike the E640, the E3800 is a full system-on-chip with an integrated controller, as well as Intel HD Graphics. The SoC is also 64-bit, making the Max one of the few 64-bit hacker SBCs available, as well as one of the few open x86-based boards. Intel also sells an open source Galileo SBC with Arduino compatibility based on its low-power, Pentium-compatible Quark processor.



E3800 SoC block diagram
(click image to enlarge)

The MinnowBoard Max's design appears to support the full range of 22nm-fabricated Atom E3800 processors, which include single-, dual-, and quad-core SoCs, with clockrates up to 1.91GHz and TDPs ranging from 5 to 10 Watts. Two standard boards are being offered initially: a $99 based on the 1.46GHz single-core E3815 (5W TDP) along with 1GB RAM, and a $129 version incorporating the dual-core E3825 (6W TDP) accompanied by 2GB RAM.

Like the BeagleBone Black, the MinnowBoard tightened up its feature set slightly in order to reduce the price. Beagleboard.org was responding to pressure from the $25/$35 Raspberry Pi when it almost halved the price of the Black to $45.

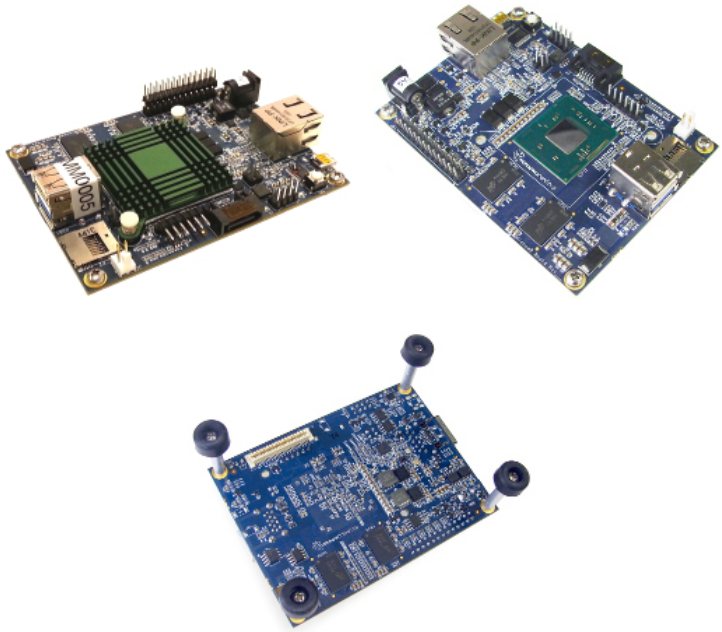
According to David Anders, Senior Embedded Systems Engineer at CircuitCo, a Ft. Worth, Texas based company that also manufactures the BeagleBone Black, the MinnowBoard Max is not intended to compete

directly with the Raspberry Pi. Yet, the SBC is certainly likely to reach a wider audience with its $99 price.

BeagleBone Black

The original MinnowBoard acted as a set of "training wheels," both for CircuitCo, which was new to x86-based boards, and Intel, which was new to open hacker boards, Anders told LinuxGizmos. Lessons learned on the original have helped steer the path to the Max, he added.

The Max should also attract developers who like their hacker SBCs as open source as possible. With its firmware roots in the Yocto Project, the Intel-backed Minnowboard.org already offered open source code and Creative Commons licenses for schematics and design files. Now, with the Atom E3800 based Max it also offers "a complete open GPU driver in the mainline kernel" for its Intel HD Graphics, says Anders.

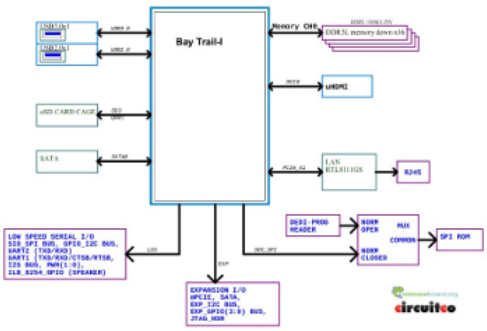


MinnowBoard Max top from two angles, and bottom showing white high-speed expansion connector
(click images to enlarge)

While the original board offered only an Angstrom Linux build based on Yocto Project code, the Max also supports a more generic Debian GNU/Linux, and offers compatibility with Android 4.4. So far, Intel has not pushed the embedded-focused Atom E3800 as an Android platform as much as it has with its mobile Atom versions, like the similarly 22nm Atom Z34xx (Merrifield).

Board shrinks, expansion splits into two connectors

Whereas the original MinnowBoard was limited to 1GB RAM, the MinnowBoard Max supports configurations of 1GB, 2GB, or 4GB. It also advances from DDR2 to DDR3 RAM. SPI flash, used to store its UEFI firmware, has been doubled to 8MB, and instead of NAND flash, you get a microSD slot. Two SATA ports (one on-board) support more robust storage.



MinnowBoard Max simplified block diagram
(click image to enlarge)

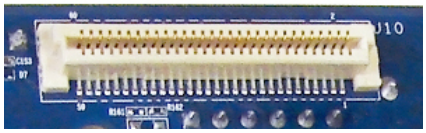
As before, coastline I/O includes gigabit Ethernet, micro-HDMI, and two USB host ports, but this time one of the USB interfaces steps up to USB 3.0. A serial debug interface and various GPIO signals (with two supporting PWM) are also available via header connectors. The Max has also lost a few on-board features. Gone are the previous micro-USB OTG and analog audio ports (digital audio is available via the board's coastline HDMI port).

Whereas previously there was a single, 100-pin expansion connector that supported stackable expansion cards called "Lures," the Max splits its I/O into two connectors. A 26-pin header connector on the top side for low-speed I/O, and a 60-pin high density connector on the reverse side of the board, for high-speed I/O.

Description	Name	PIN	PIN	Name	Description
Ground	GND	1	2	GND	Ground
+5V Power	VCC	3	4	+3V3	+3.3V Power
SPI Chip Select 1	GPIO_SPI_CS#	5	6	GPIO_UART1_TXD	UART Transmit
Master In/Slave Out	GPIO_SPI_MISO	7	8	GPIO_UART1_RXD	UART Receive
Master Out/Slave In	GPIO_SPI_MOSI	9	10	GPIO_UART1_CTS	CTS/GPIO
SPI Clock	GPIO_SPI_CLK	11	12	GPIO_UART1_RTS	RTS/GPIO
Clock/GPIO	GPIO_I2C_SCL	13	14	GPIO_I2S_CLK	Clock/GPIO
Data/GPIO	GPIO_I2C_SDA	15	16	GPIO_I2S_FRM	Frame/GPIO
UART Transmit/GPIO	GPIO_UART2_TXD	17	18	GPIO_I2S_DO	Data Out/GPIO
UART Receive/GPIO	GPIO_UART2_RXD	19	20	GPIO_I2S_DI	Data In/GPIO
GPIO/Wakeup	GPIO_S5_0	21	22	GPIO_PWM0	PWM/GPIO
GPIO/Wakeup	GPIO_S5_1	23	24	GPIO_PWM1	PWM/GPIO
GPIO/Wakeup	GPIO_S5_4	25	26	GPIO_IBL_8254	Timer/GPIO

Low-speed I/O header signals
(click image to enlarge)

The low-speed expansion header is somewhat similar to that of the Raspberry Pi's 50-pin connector, providing Arduino-like prototyping I/O including I2C, SPI, PWM, I2S, and various UARTs and GPIO, as listed above.



High-speed I/O connector

Signals included on the white, high-speed expansion connector on the back of the board include a single PCIe Gen 2.0 lane (down from the previous board's two lanes), a second SATA interface, an additional USB 2.0 host port, GPIO, and JTAG support. Overall, the device has 14 fewer expansion pins, and has lost several of the earlier board's interfaces including CAN, SMB, and LVDS.

Two new Lure formats

Like the original MinnowBoard, the Max supports standardized expansion boards, called Lures. However, due to the Max's new use of dual expansion connectors — dedicated to low-speed and high-speed signals, respectively — Lures designed for the original MinnowBoard are incompatible with the Max. Consequently, the MinnowBoard Max introduces two new add-on module formats: low-speed MinnowBoard Max Lures, and high-speed MinnowBoard Max Lures.

"Since the low speed connector is very similar to the signals available on most Arduino platforms, a wide range of Arduino Shields that are released under creative commons will be redesigned for MinnowBoard Max," explains Anders. "This allows developers to take advantage of a wide range of [existing] tutorials as well as easily prototype projects."

Arduino shields expected to be converted into low-speed Lures include the ADC Shield, PWM Shield, Moto Shield, Relay Shield, and CAN Bus Shield. "We currently have a list of 28 Arduino shields that are released under creative commons that will be redesigned specifically as Lures for the MinnowBoard Max," Anders told LinuxGizmos. In fact, CircuitCo is developing a Lure similar to the current BeagleBone Audio Cape, which provides various analog audio options.

The Max's high-speed expansion connector, meanwhile, provides signals that can be used for implementing high-speed Lures that leverage off-the-shelf mini-PCIe and/or mSATA cards, noted Anders.

Summary of specifications

Specifications listed for the current MinnowBoard Max models include:

- Processor — Atom E3800 (Bay Trail-I) with Intel HD Graphics:
  - Single-core E3815 @ 1.46GHz (5W TDP)
  - Dual-core E3825 @ 1.33GHz (6W TDP)
- RAM — supports 1GB, 2GB, or 4GB DDR3 RAM (depending on model)
- Flash — 8MB SPI flash (for UEFI/Coreboot/etc.)
- Coastline I/O:
  - MicroSD slot
  - Micro-HDMI port
  - Gigabit Ethernet port (RJ45)
  - Dual USB ports — 1x USB 3.0 host; 1x USB 2.0 host
  - 1x SATA 3Gb/sec port
- Expansion connectors:
  - Low-speed connector (26-pin) — SPI, I2C, I2S audio, 2x UARTs (TTL-level), 8x GPIO (2x supporting PWM), +5V, GND
  - High-speed connector (60-pin) — 1x PCIe Gen 2.0 lane, 1x SATA 3Gb/sec, 1x USB 2.0 host, I2C, GPIO, JTAG, +5V, GND
- Other features — serial debug port (header); firmware flash port (header); heatsink; ACPI 5.0 support
- Operating temperature — 0 to 70° C
- Power — 5VDC
- Dimensions — 99 x 74mm (3.9 x 2.9 in.)
- Operating system — Debian GNU/Linux; Yocto Project Linux; Android 4.4

Further information

The MinnowBoard Max will go on sale early in the third quarter. Two versions will be offered initially: a $99 entry-level model, with a 1.46GHz single-core E3815 SoC and 1GB RAM; and a $139 model, equipped with a 1.33GHz dual-core E3825 SoC and 2GB RAM. CircuitCo is evaluating demand for a quad-core model, but that has not announced any details or availability yet. Additional information is available at the Minnowboard.org website, and at CircuitCo's MinnowBoard product page.

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- Open Atom SBC runs Angstrom Linux, nears production
- Let the 1st annual Open SBC Games begin!
- Intel unveils second generation Galileo hacker SBC

- Linux-based K-9 doppelganger treads ELC
- Dev board targets Atom Z3000 tablet designers
- Intel contest encourages Yocto Project-based device designs

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PLEASE COMMENT BELOW

7 responses to "Intel unveils tiny $99 MinnowBoard Max open SBC"

1. *ron minnich* says:
   Mar. 31, 2014 at 10:10 am

   Here we go again: "… open source UEFI firmware …."

   This is worth checking but usually when the "open source UEFI firmware" claim is made, it's not true. Vendors (marketing guys, I guess) have got into the habit now of routinely making the claim that something is open source, when it is not. I am sure they don't realize they are being untruthful.

   Reply
   - *LinuxGizmos* says:
     Mar. 31, 2014 at 10:22 am

     You are correct: the UEFI firmware is NOT open source. In this case it was our error, not Intel's.

     Reply
2. *Wilfred Diamond* says:
   Apr. 2, 2014 at 2:46 pm

   "The $99 model presumably uses the 1.46GHz, single-core E3815, which has a low 5W TDP. Three dual-core models are available ranging from 1.33GHz to 1.75GHz, and 6W to 8W TDPs, respectively. The quad-core Atom E3845 features 1.91GHz performance at 10 Watts."

   Will there be a quad core version of the Minnow Board or is this just speculation on the part of LinuxGizmos?

   The MinnowBoard site only mentions at

   QUOTE

   $99 MSRP: E3815 (single-core, 1.46 GHz)
   $129 MSRP: E3825 (dual-core, 1.33 GHz)

   UNQUOTE

   Or does LinuxGizmos have access to yet to be released "inside" information about MinnowBoard?

   Reply
   - *LinuxGizmos* says:
     Apr. 2, 2014 at 5:14 pm

     We've been told by Intel that the design supports all of the processors we listed. However, Intel and CircuitCo are only building the two models initially. With enough pressure from potential customers, it's possible they would put a quad-core model into production.

     (Maybe someone from CircuitCo or Intel could comment here?)

     Reply
3. *peanut shell* says:
   Apr. 3, 2014 at 5:38 pm

   Hmmm most online sources are listing this for $180+…wtf? Ain't nobody got time for that!

   Reply
   - *LinuxGizmos* says:
     Apr. 3, 2014 at 6:32 pm

     You are seeing the original MinnowBoard, which has MSRP of $199, I think, so they appear to be discounting the older model. MinnowBoard Max won't be shipping for a couple of months.

     Reply
4. *direction* says:
   Apr. 7, 2014 at 1:23 am

   I Just doubt the price or Lures board.
   for PCIe interface, it is obviously an advantage compared with ARM based development board

   Reply

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