

## iPhone 4S Carries BOM of \$188

Published on Wireless Design & Development (<http://www.wirelessdesignmag.com>)

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On the outside, the iPhone 4S may have disappointed some with its perceived lack of new features. But on the inside, the latest member of the iPhone line includes a wealth of innovation, including a new wireless module with a unique custom module from Avago Technologies Ltd.—and the first use of a Hynix Semiconductor Inc. NAND flash memory in an Apple Inc. iPhone product, according to a new IHS iSuppli Teardown Analysis from information and analysis provider IHS (NYSE: IHS). The baseline iPhone 4S model with 16 gigabytes (GB) of NAND flash memory carries a bill of materials (BOM) of \$188. When the additional \$8 manufacturing cost is added in, the total increases to \$196, as presented in the table below. The other iPhone 4S models are identical to the baseline version, with the exception of the addition of more NAND flash. This gives the mid range, 32GB model a BOM of \$207, and the high-end 64GB version a BOM of \$245.

**Preliminary Bill of Materials (BOM) Estimate for the Major Subsystems in the iPhone 4S (in U.S. Dollars)**

	4S		
	16GB	32GB	64GB
Retail Price w/Contract	\$199	\$299	\$399
Total BOM Cost	\$188	\$207	\$245
Manufacturing Cost	\$8	\$8	\$8
BOM + Manufacturing	\$196	\$215	\$254
<b>Major Cost Drivers</b>			
<b>Memory</b>			
NAND Flash	\$19.20	\$38.40	\$76.80
DRAM (DDR / DDR2)	\$9.10	\$9.10	\$9.10
<b>Display &amp; Touch Screen</b>			
Display	\$23.00	\$23.00	\$23.00
Touch screen	\$14.00	\$14.00	\$14.00
Processor	\$15.00	\$15.00	\$15.00
Camera(s)	\$17.60	\$17.60	\$17.60
Wireless Section - BB/RF/PA	\$23.54	\$23.54	\$23.54
User Interface & Sensors	\$6.85	\$6.85	\$6.85
WLAN / BT / FM / GPS	\$6.50	\$6.50	\$6.50
Power Management	\$7.20	\$7.20	\$7.20
Battery	\$5.90	\$5.90	\$5.90
Mechanical / Electro-Mechanical	\$33.00	\$33.00	\$33.00
Box Contents	\$7.00	\$7.00	\$7.00

Source: IHS iSuppli October 2011

Please note that these teardown assessments are preliminary in nature, and account only for hardware costs and do not include other expenses such as software, licensing, royalties or other expenditures.

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“While the iPhone 4S shares many common design elements with the two iPhone 4 models already on the market, the new device’s status as a world phone has resulted in fascinating design and component changes,” said Andrew Rassweiler, senior director, teardown services, for IHS. “Key among these changes is a custom part from Avago that helps give the iPhone 4S its unique capability to be used in multiple wireless systems globally, while still keeping costs down. In another surprise development, the 4S employs a Hynix NAND flash memory device. While IHS has already confirmed multiple suppliers for this part, it does mark the first time that IHS has identified a Hynix NAND flash in an iPhone, as opposed to devices from Samsung Electronics Co. Ltd. or Toshiba Corp. seen in all previous iPhone and iPad teardowns.”

### **Change is in the air**

The wireless section of the iPhone 4S brings a significant upgrade in capabilities compared to previous members of the iPhone line, employing a dual-mode design that supports air standards for all wireless service partners supported by Apple worldwide. This represents a unique design approach compared to that used by most cell phone makers, which use different models with unique wireless subsystems to support various wireless carriers’ standards. It also represents a major upgrade from the iPhone 4, which used two separate versions to support the high-speed packet access (HSPA) and code division multiple access (CDMA) wireless networks.

### **Enter the Avago**

A critical component enabling the worldwide capability of iPhone 4S is the ACPM-7181 converged power amplifier module (PAM) from the previously unheralded supplier Avago.

A PAM is a device that amplifies a radio signal prior to transmission. What makes the converged Avago part unique is its capability to support both 2G and 3G cellular technologies across multiple bands thus reducing the number of components and PC board footprint required. While Avago is by no means the only company supplying these types of devices, it is the first to be implemented by Apple.

“Avago’s ACPM-7181 is a unique and valuable part in the iPhone 4S wireless subsystem, representing a truly converged power amplifier that can be used across global wireless systems,” Rassweiler said. “This custom device merges the functionality previously implemented in three separate components in the HSPA iPhone 4 model: the two Skyworks Solutions Inc. PAMs and one TriQuint Semiconductor Inc. PAM. This is a very special converged approach that gives Apple a real technology lead over most other manufacturers, further reducing the complexity of the radio frequency/power amplifier (RF/PA) section of the iPhone line beyond Apple’s already highly-integrated design.”

Beyond benefitting Apple, the iPhone design win also may turn out to be a major boon for Avago.

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“Avago presently is ranked as a second-tier supplier well behind leading power amplifier suppliers such as Skyworks, RFMD and TriQuint,” said Francis Sideco, senior principal analyst, wireless communications for IHS. “However, with the inclusion of its custom PAM in the highly popular iPhone line, Avago now is going to be in contention to become a first-tier supplier.”

### **Qualcomm scores a win**

Another key device enabling the global wireless capability of the iPhone 4S is the MDM6610 baseband processor from Qualcomm Inc.

“Qualcomm obviously is a big winner in the 4S, with company now taking sole ownership of the baseband processor position with its MDM6610 device,” said Wayne Lam, senior analyst, wireless communications for IHS. “While the Qualcomm MDM6600 was in the CDMA version of the iPhone 4, the Intel (formerly Infineon Technologies AG) PMB9801 was used in the HSPA model. In the iPhone 4S, Qualcomm no longer has to share the iPhone 4 baseband design win with Intel. It will be interesting to see how Intel responds in terms of winning back this socket in the next design cycle.”

### **Hynix makes a surprise appearance**

In the individual iPhone 4S torn down by IHS, the NAND flash was supplied by South Korean memory manufacturer Hynix. This represents a major design win for the company, with the NAND device accounting for a major portion of the value of the iPhone 4S. Toshiba has also been positively identified as a second source for the NAND in other iPhone 4S samples.

In the 16GB version of the 4S, the memory subsystem costs \$19.20, making it the second most expensive single component after the display. However, the cost of the NAND rises to \$38.40 in the 32GB version and to \$76.80 in the 64GB model, making it the most expensive set of components in the system.

### **Other innovations**

Other new components in the iPhone 4S include the use of a dual core A5 apps processor. Just as with the A4 used in iPhone 4, the part appears to be manufactured by Samsung, based on die markings on the product.

In another change, the camera module in the iPhone 4S features an 8 megapixel camera, compared to a 5 megapixel device used in the iPhone 4. The camera uses a backside illumination (BSI) image sensor that improves photo quality, especially in low light, but also adds cost to the system. Sony was the supplier of the image sensor in the individual model torn down by IHS, but Apple likely is using a secondary source for this device: OmniVision.

### **Design leftovers**

While there are changes, the iPhone 4S maintains many of the same design

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elements and components as the iPhone 4 models.

One major area that has remained the same is the display and touch screen section, which together represent the single most expensive subsystem in the iPhone 4S.

Other components that were more or less unchanged include the Wi-Fi/Bluetooth/Frequency Modulation (FM) module from Murata Manufacturing Co. Ltd. and Broadcom Corp. and the audio codec from Cirrus Logic Inc.

To learn more about this topic, see the IHS iSuppli [Apple iPhone 4S \(16GB\) Mobile Handset Hardware Analysis](#) [1].

**Posted by Janine E. Mooney, Editor**

October 21, 2011

**Source URL (retrieved on 03/05/2015 - 10:57pm):**

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