

[Teardown: Inside Given Technology's Pillcam Colon 2](#)

[Patrick Mannion](#) - October 04, 2012

Anyone who's ever had to endure an endoscopy or colonoscopy knows those tests can be, so to speak, a bitter pill to swallow. Given Imaging's Pillcam Colon 2 ingestible capsule offers a friendlier alternative for getting a good look at your innards, from stomach to lower intestine, with less chance of mortality. Now *there's* an incentive.

A bit larger than your average vitamin, without the option to blend it in a shake, the Pillcam Colon 2 is a classic exercise in low-power wireless system design, with advanced imaging and novel packaging techniques.



To use the device, the subject swallows the capsule. The images it captures are sent to a sensor array that is worn strapped to the subject's chest and that connects to a data recorder. The subject returns the recorder to the doctor the next day and excretes the use-once Pillcam within a couple of days. (FYI—or perhaps this is TMI—subjects have been known to retrieve and save their capsules for posterity.)

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Just to show how smart Given Imaging really is, the Pillcam Colon 2 developers didn't do the wireless design themselves. Other companies had tried that but eventually turned to the experts; see "[Fitbit blends wireless, MCUs, and MEMS with online interface.](#)" Instead, Given Imaging consulted the experts at Zarlink Semiconductor, now part of Microsemi Corp. Microsemi, in turn, worked closely with the image-sensor experts at Aptina Imaging Corp to develop the device and optimize it to the nth degree. Images here and on the next page offer a look at what they did.

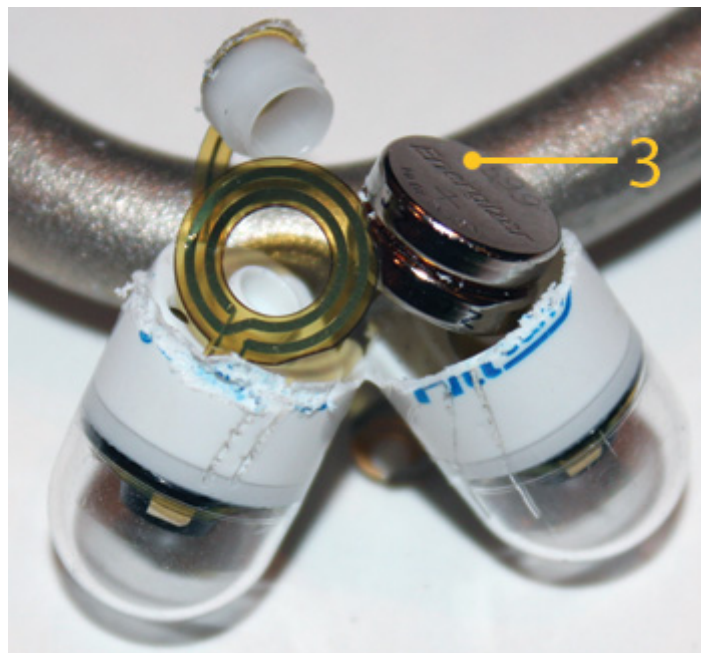
The Colon 2 received the CE Mark in September 2009 and is commercially available in Canada, Europe, Latin America, and parts of Asia. Given Imaging has submitted the product for FDA approval.



1. When the unit is closed, two magnetic strips on the lid activate a MEMS switch to keep Pillcam Colon 2 in the off state. The Pillcam activates when the lid is opened.

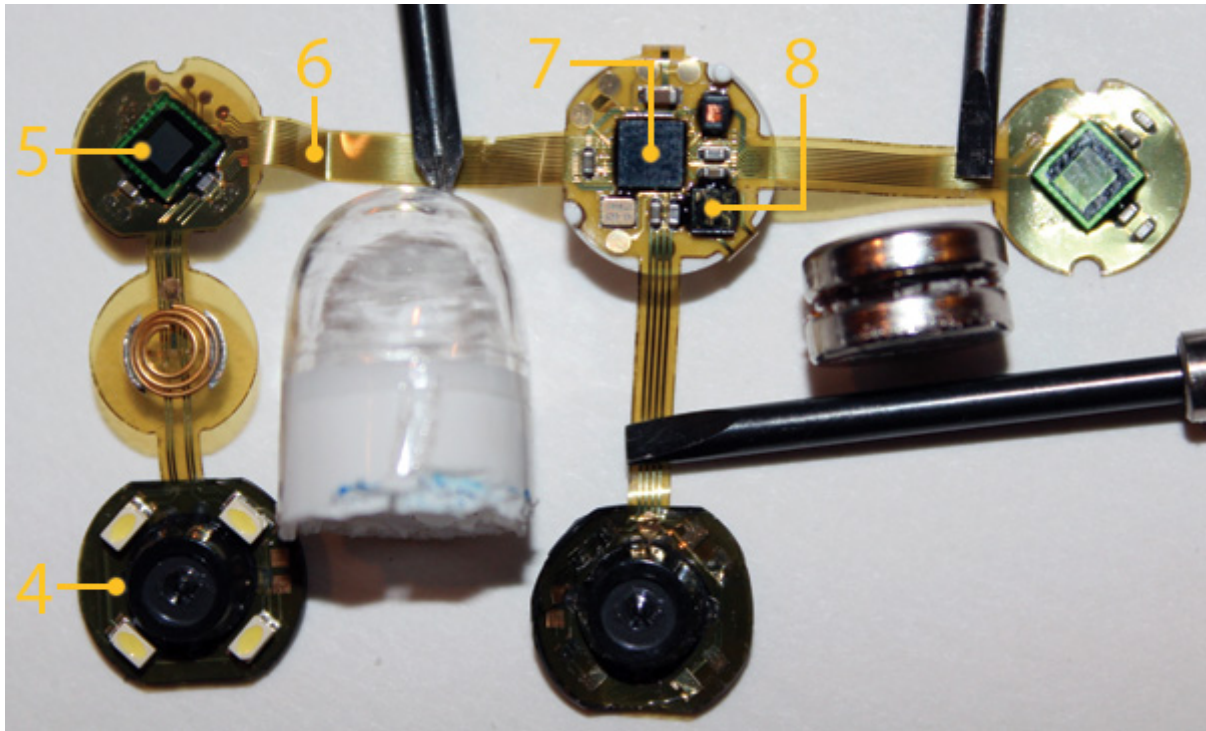


2. The Pillcam Colon 2 measures 11×26 mm and weighs less than 4g. The four LEDs on each end of the pill flash alternately and allow images to be taken looking forward and behind, deep into the colon mucosa, as the capsule tumbles. There is one Aptina CMOS image sensor at the center of each end of the Pillcam.



3. Power derives from two Energizer 399 1.55V, 54-mAhr silver-oxide coin cells, each weighing 0.8g and taking up a third of the overall volume.

Title-2



4. Here's one of the two lenses, surrounded by four white LEDs.

5. This is one of the unit's two Aptina MT9S526 5.6-micron CMOS image sensors, capable of 4 to 5 fps in a 1/6-in. optical format.

6. The polyimide flex circuit allows the device to be fully assembled flat using standard manufacturing assembly, then folded around the battery in the center of the capsule.

7. The custom chip includes a proprietary Microsemi (Zarlink) fully integrated, third-generation sub-GHz ISM-band radio combined with a custom, 8-bit Harvard-architecture control circuit. The radio link is asymmetric: Tens of kbits/sec down-channel allow device control (frame rate, power use, etc.); 5 Mbits/sec up-channel enable 28-fps, full-color image transfer. The range is 1 to 2 feet in the body and tens of meters line of sight.

8. The MEMS switch probably uses a cantilever design.

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