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Shimano Shuns Cables for Full Electronic Shifting

By Eric Hagerman 2 hours ago



Stefan Schumacher of Germany speeds down Ombarde Pass using Shimano's Di2 electronic shifting system during the 2008 Tour De France. Photo: Christophe Ena/AP

Japanese parts manufacturer Shimano is launching an electronic shifting system for high-end road bikes that it claims will vastly improve performance and reduce maintenance. By replacing the conventional levers that pull wound-steel cables through protective housings with solid-state switches and rubber-coated wires, there's no chance for road gunk to clog things up and interfere with shifting, or, for that matter, your post-ride beer.

The principle of an electronically controlled drive train is to execute perfect shifts every time, thus "reducing mental overhead," in the words of Shimano marketing manager Devin Walton. This is a resource cyclists find in short supply during epic rides. Thursday's announcement that the system, called Di2, will hit shops in January 2009 settles a question first raised in 2005 when prototypes began cropping up on the bikes of select Shimano-sponsored racers in the pro *peloton*. The system's development has been photographed, chronicled and Angsted over ever since.

But if the existence of electronic shifting comes as no surprise, its weigh-in certainly should. During a recent telephone interview, an industry insider who spoke on condition of anonymity stopped cold amid a why-do-we-need-this diatribe, upon learning that Di2 weighs less than Shimano's current generation of parts. According to the company, Di2 will be 67 grams lighter than the current *Dura-Ace 7800* and only 68 grams heavier than *Dura-Ace 7900*, the snazzy forthcoming 2009 suite of parts. "I'll be going to hell," said the source, who then fell silent -- no doubt converting grams to ounces to fractions of a pound to the limitless advantages of such weight savings. That's at least an extra Clif Bar.

Shimano plans to offer the electronic setup as an upgrade option within the 7900 group -- which is preselling for \$2,600 -- so parts such as the two-tone cranks and brakes will be the same. (No word yet on the additional cost for electric; it could be double.) Di2 consists of two brake-and-shift levers, two derailleurs whose springs have been replaced by servo-motors, a 7.4-volt lithium-ion battery pack, and the wiring harness that connects everything.

The derailleurs, whose job is to move the chain from gear to gear as you shift, talk to each other and automatically adjust so the chain doesn't rub. They also calibrate themselves, so you don't have to play with cable tension to maintain shift quality as cables stretch and the chain and cogs wear. And although the control buttons have been placed in the traditional location behind the brake levers -- so as not to confuse anyone or overly tax that mental overhead -- they could be integrated with the ends of time-trial bars, the top of the handlebars or just about anywhere a rider might find convenient.

Still, the advantage that people who've experienced the system talk about is how little effort it takes to change gears. A quick nudge to one of the shift switches signals a motorized worm gear in the derailleur to instantly move the precise amount it needs to. Fractions of a second later, the chain snaps into position.

Chris d'Aluisio, director of advanced research and development for Specialized, likens the difference between mechanical and electric shifting to the difference between driving a race car with a manual transmission and one with F-1 style paddle shifters. "You can stay on the gas and flip through the gears with no hesitation," said d'Aluisio. "It's seamless power."

Frankie Andreu, who raced in nine Tours de France, described the shifting as "immediate and very smooth and accurate.... It's super nice." Even my curmudgeonly unidentified source said, "The shifting is mind-blowing: I mean, you just touch the button, and it shifts."

But let's not lose perspective. Shimano isn't the first company to attempt electronic shifting. Mavic introduced *Zap* in 1994 and then a wireless version called *Mektronic* in 2000, neither of which survived. *Zap*'s wires proved to be less than waterproof, and *Mektronic* was finicky to set up properly. Shimano, notorious for its rigorous testing gauntlet, is betting that its engineers have solved the electricity problem -- and so is Campagnolo, a competitor that is on a similar development path but has yet to announce when it will release its system.

The crux of the engineering challenge is making the battery light yet long-lasting, so Shimano's engineers turned to the hardest-working part in any shifting system: the front derailleur. It's also the most temperamental, with a nasty habit of dropping or jamming the chain if the rider doesn't modulate his tempo properly while shifting. (Mavic didn't even go there -- only the rear was electric.) To be fair, the front derailleur has the notably tough job of moving a chain under heavy load between two gears of dramatically different sizes, moving at different speeds. The Di2 crew knew going in that it would require three or four times the juice of the rear derailleur.

So, when Shimano started out in 2003, the initial strategy was to throw a bunch of power at the problem, and take advantage of the servo-motor's massive torque. But this came at too high a cost, according to former Olympian Wayne Stetina, a Shimano vice president whose primary job is to test equipment and provide feedback to the engineers in Japan. "As I recall, in 2004 we had a much larger battery that went dead on me several times during long rides," said Stetina, who has logged 19,000 miles on various iterations of Di2. "It couldn't last more than three or four hours between charges, and the battery pack and



Di2's front derailleur automatically adjusts itself so the chain doesn't rub as you shift.


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control system weighed nearly a pound."

That wasn't going to fly in a sport where grams can



Shimano claims that the 7.4-volt lithium-ion battery will go 1,000 kilometers between charges.



The shift buttons are located in the traditional place -- behind the brake levers -- but they could go anywhere without affecting the performance of the system.

translate directly into seconds. The trick would be to conserve power, not squander it. Shimano's engineers redesigned the geometry of the front-derailleur to amplify the force, so they could get the necessary output with far less input. The greater leverage of the new derailleur allowed for a much smaller battery and ultimately shaved half a pound off the system. Stetina claims the battery consistently lasts 2,000 miles between charges (which takes 90 minutes). Officially, Shimano says the battery will last for 1,000 kilometers (621 miles). The front derailleur doesn't actually move with more force or more speed, as you might assume. It does receive the signal to shift faster than you can send one by cranking on your lever and fighting against friction, spring tension and a lesser mechanical advantage. More important, it should do the same exact thing, every time, without needing to be coaxed or cursed. Powered as it is by an electric motor, the front derailleur simply moves a calibrated distance when it's told. "It just jams the chain into the big ring, no matter how much load is on it," d'Aluisio said. "You don't lose any momentum, and your legs never stall."

Road-bike aficionados are much like trout: simultaneously enthralled and mortified by anything shiny and new that enters their environment. And so it's not surprising that the first two questions people tend to ask about Di2 are: 1) What if the battery dies? and 2) What if it gets wet? Stetina believes he's personally answered the first. And besides, he said, there is a battery meter on the Flight Deck computer (which includes heart rate, altimeter, inclinometer, calorie counter and the ability to download all these details to your PC after the ride). His unscientific-but-admirable strategy for testing the waterproofness of the system has been to blast the components with the high-pressure hose at a coin-op car wash. Presumably Shimano's engineers in Japan have more-traditional testing methods. The company prides itself on systems engineering, and has been working on this set of components for more than five years. How will it work? You can find out for yourself when Di2 goes on sale in January. Call us when you've put 12,000 miles on it.

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