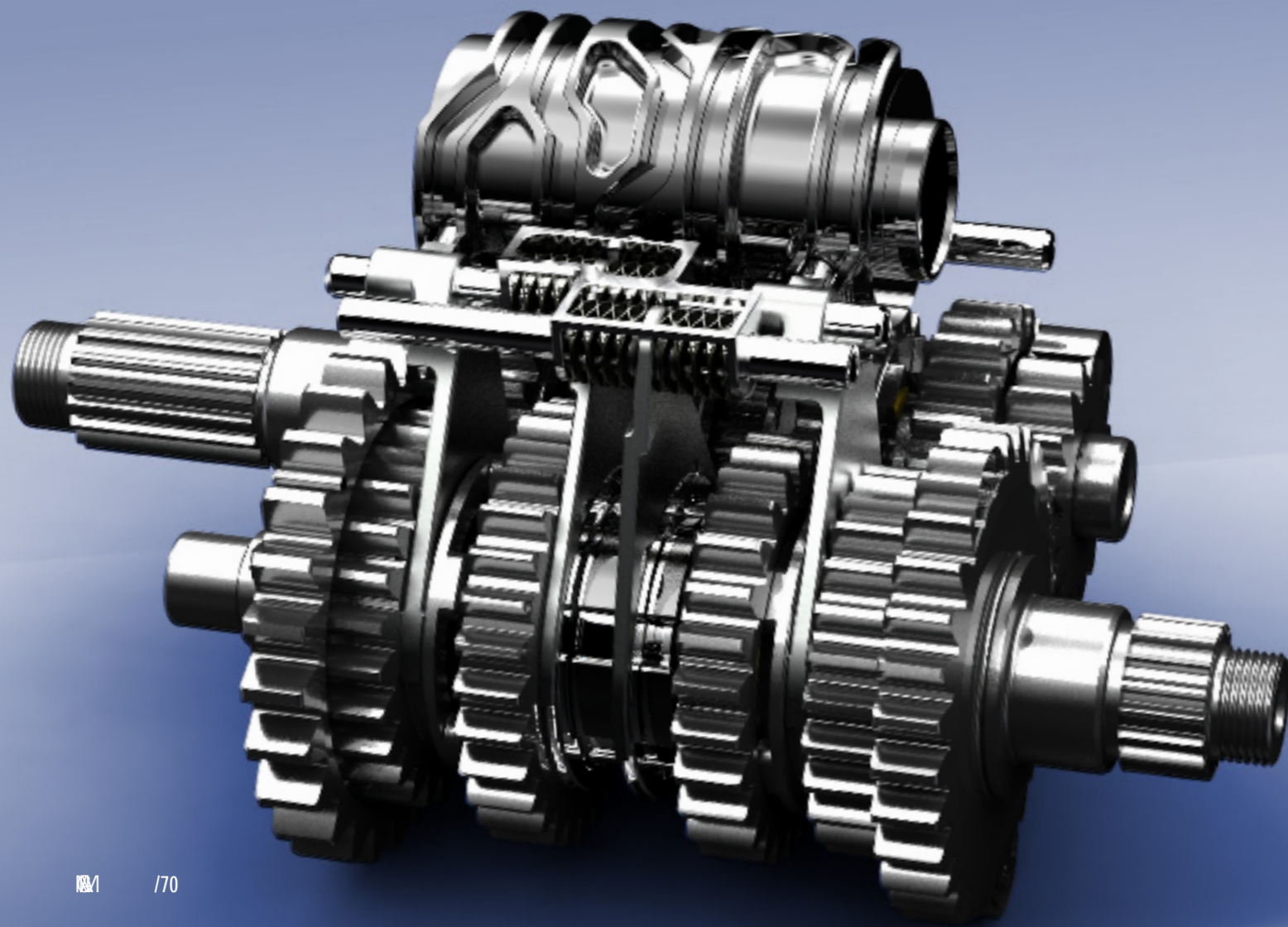
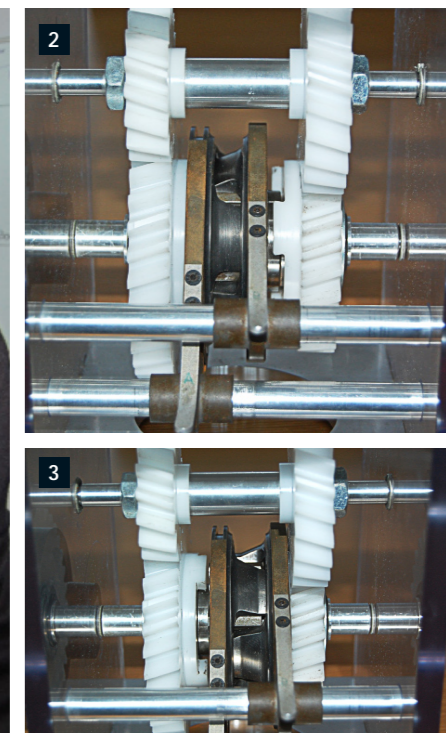


SEAMLESS TRANSITION

Seamless-shift gearboxes will appear in roadbikes by 2012 – the technology straight off Honda's RC212V MotoGP machine



1. Darren Mescall operates a small hand-wound model of the seamless-shift transmission
2. First gear fully engaged – notice the left dog teeth merging with the bullet ring
3. Second gear fully engaged – notice bullet ring on right now fully engaged



Honda's 2011 RC212V MotoGP bike was already looking hard to beat even before the first round of the championship, with all fingers pointing towards the firm's 'mystery' seamless-shift transmission system as the reason for the bike's new-found pace.

While details of Honda's gearbox are still a closely guarded secret, several experts have suggested that British gearbox specialists Zeroshift could be behind the technology. So we thought we'd pay them a visit to see just what's going on and discovered that, far from being a purely race-oriented technology, seamless-shift gearboxes are on the verge of appearing on production machines.

Although confidentiality agreements mean Zeroshift won't mention the names of the companies it's working with, it's clear that Honda's MotoGP transmission, which is estimated to be worth between 0.3 to 0.5 seconds per lap, is either a Zeroshift-designed system or something very similar. More surprising is the fact that, far from being a race-only set-up, Zeroshift says it's already working with more than one major manufacturer with the intention of introducing exactly the same technology on production bikes.

Zeroshift design engineer Darren Mescall said: "We're just on the verge. It's taken five years to develop an operating system and in the last year we've had at least two customers who are willing to go further. They're in the late prototype stages, so they're testing at present and, certainly by the end of the year, we should have a large announcement to make to say 'we're going into production'."

So it appears that seamless-shift gearboxes will be in showrooms soon, maybe

even as early as next year, but what are they?

Whenever you change gear – regardless of how fast you do it and whether or not you use the clutch – you're disengaging one gear and creating a momentary gap in power delivery before the next ratio is engaged.

Basically, for a brief moment, your bike is free-wheeling. If you're accelerating that means there's a moment where the acceleration stops, resuming again when the next gear takes up drive. If you're changing down it means you're losing the engine-braking effect for a moment. On the road it's relatively easy to paper over these cracks in power delivery with a bit of deft clutch and throttle control, but that's not addressing the basic problem – and on the track those moments with no power add up over a lap, resulting in a significant loss in pace.

Seamless-shift transmissions solve the problem, switching between ratios without ever cutting drive to the rear wheel.

HOW IT WORKS

There are several firms developing seamless-shift transmissions but Zeroshift's design is probably the best contender for use in bikes thanks to its ability to replace a conventional transmission with minimal changes to the transmission casing or the gear linkage.

Taking just two gears as an example – say first and second – both can spin freely on the output shaft of the gearbox and are permanently meshed with their counterparts, which are firmly fixed to the input shaft. On a normal "dog" gearbox, a "dog ring", sliding along a spine on the output shaft, sits between the two gears. Slide it one way and lumps on the side of the adjacent gear (called "dogs") will engage with matching notches in the dog ring, so the

dog ring locks the gear to the output shaft. Now the input and output shafts are both spinning: you're in first gear.

Slide the dog ring the other way and another set of dogs engage the second gear ratio. In between will be a space where the dog ring can spin, engaging neither gear – the "neutral" position.

Zeroshift's system allows the changeover from one gear to the next without having to go through that neutral position.

Between the gears it has two bullet rings, each holding three bullets – specially shaped dogs that can engage onto teeth on the sides of the gears. To select first gear, one ring is moved until its bullets hook onto the drive teeth on the side of first gear. The second ring is then moved the same direction, its bullets filling in the gaps between the teeth so there's no slack, or backlash, if you come off the throttle.

The clever bit is that this second set of bullets isn't under any load, the ring holding them can be easily slid across towards the second gear. Because second will be turning faster than first, the teeth on the side of that gear will hook onto the dogs, in turn accelerating the output shaft's speed. The bullets that were taking the load from first gear will therefore be unloaded and the ring holding them will be able to slide across, taking up the backlash on second gear.

Don't worry if you don't get it – if you need to see how it works there are animations on the Zeroshift website that make it clear as day (www.zeroshift.com).

Mescall said: "One of the major benefits is that not only is it seamless on an upshift, for acceleration, but also during a downshift, which is critical for fast cornering or late braking. You can even change gear mid-corner without upsetting the vehicle."

