

# Full Throttle

The Formula Renault 3.5 is seen as a crucial stepping stone on the way into the premier class, the Formula 1. Ambitious racers do not just bring their talents—they also have Maxon motors on board to control the throttle of their 530-hp V8 engines.

Andreas Turner, Maxon Precision Motors

Top gear. 160... 170... 180... 185... The back of Nico Müller's neck is pushed against the edge of his bucket seat under the pressure. Strangely, it does not relent even after reaching the top speed of 193 mph. The 21-year-old executes the required steps as if in an oxygen intubation: inhale, exhale, raise shoulders, drop shoulders, all with exaggerated slowness to ride out the adrenaline rushes.

## Exploding fuel vapors

The tachometer shows 9,000rpm as the pistons of the V8 rip a torrent of fresh air through the fully open throttle flaps. In the cylinders, fuel vapors detonate in controlled explosions, delivering brutal acceleration. A sharp bend, initiated with a quick dip of the left foot on the brake pedal, causes a centrifugal pull on tires, suspension,

chassis, and neck muscles. And yet, the car cuts smoothly along the track in the midst of a lush green area interspersed with a few trees. The one-seater purposely winds its way through the Royal Park in Monza, past the Milano Golf Club. The down pressure from wings and diffusers now exceeds the weight of the Formula Renault 3.5 car—strong enough to activate the natural laws of compression. Under the heat of the load, the steering seems to have merged into a unit reaching all the way up into the driver's shoulders. The carbon brakes could hurl Müller

into his harness with a force equal to three times his own weight.

## Fine tuning

The pit stop at Draco International Racing in the Autodromo Nazionale di Monza: "We nailed it this lap, the car felt great on every section of the track," Müller says. He flashes a relaxed smile. Before the actual lap time was announced, the young man from the Bernese Oberland knew instinctively that he would appear in the upper reaches of the provisional ranking. As he turns to walk off towards the shower, he lets the pit master know where the set-up of the 610kg Zytek-powered Formula Renault could use some fine tuning.

"We are working on the details of the adjustable rear wing and the pedal mapping, even if we gain less than one tenth of a second per lap in the end," says Draco Team Manager Simone Giglio. He explains how the characteristic fields of the accelerator pedal, the so-called pedal maps, affect the performance and drivability of the engine. "It is always about the relationship between speed and accelerator



Nico Müller is a professional race car driver from Switzerland (all photos courtesy of Maxon).



Maxon motors and gearheads provide innovative technology for racing applications.

position. Thanks to drive-by-wire, the electronic throttle control, this can be defined in almost any way.” Even some serially manufactured sports cars today are using this technology to provide a more dynamic characteristic as an option. Drivers can choose a more direct response from the engine. It becomes quicker and feels more like a racing unit.

### Butterfly throttles

The Zytek engines used in the Formula Renault 3.5 are equipped with so-called butterfly flaps that are mounted on a rotating axle. At full throttle, the flap is vertical, offering no resistance to the air flowing into the cylinder. To close, it rotates into a horizontal position and interrupts the air flow. The precise control of the Zytek throttle system is handled by a Maxon RE-series DC motor and planetary gearhead. All eight flaps are connected with a single mechanism. They open and close in only 10

and a reinforced commutation system. All motors in the RE series have an ironless rotor and high-power permanent magnets (rare earth). They achieve more than 90% efficiency. To provide more torque for controlling the throttle of the Zytek V8 engine, the RE 35 is fitted with a GP 32 high-power planetary gearhead featuring an optimized output shaft. Depending on the reduction ratio, it can deliver up to 12 Nm.

### Reliable under extreme conditions

The challenging application conditions—strong vibration and temps reaching up to 130 degrees Celsius—made special adaptations on the motor and gearbox necessary. John Manchester, Zytek operations director: “The support from Maxon motor during the test and evaluation phase has ensured that the motor is working flawlessly and reliably even in difficult conditions.”

In the past, Draco Racing had pilots like Felipe Massa, Pastor Maldonado and Rubens Barrichello under contract. In other teams, the Formula Renault 3.5 has brought forth drivers like Sebastian Vettel, Fernando Alonso, and Robert

Kubica. Vettel is a four-time Formula 1 world champion, Alonso has won the title twice. Muller’s own resume includes a victory in Monaco, a victory in Budapest and a 5th place finish in the Formula Renault 3.5. His 2013 statistics have earned him a promotion. In 2014, he now spends the racing season as a factory driver for the Audi team in the famous Deutsche Tourenwagen Mas-



The Maxon RE 35 has an ironless rotor and high-power permanent magnets suitable for the efficiency gains needed in racing.

ters (DTM), trading in his Formula Race Car for one with a roof.

It’s time to go home. Müller, dressed in denims and a polo shirt waves goodbye to the team before turning to the reporter: “The only times when you really control a race car is at full throttle and when braking.” While the reporter is still thinking about what he just heard, Müller opens the trunk of his rental car, drops in his XXL training bag and gets behind the wheel to drive back to the hotel. His driving is slow, almost conspicuously unobtrusive. **PTE**

### For more information:

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to 15 milliseconds—comparable with the flash of a camera. On a high-speed racetrack like Monza, the car is at full throttle about 70 percent of the time. The throttle flaps open and close about 100 times per lap. During a fast lap, such as 1:35 minutes, they change position about every 0.9 seconds.

The RE 35 DC motor is fitted custom quiver brushes, a special epoxy resin

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