

TE CONNECTIVITY

# GARAGE GUIDE



FORMULA E



HIGH VOLTAGE INSIDE  
DO NOT OPEN



# POWERING THE FUTURE

## **MILLISECONDS MATTER.**

It's the difference between 1st and 2nd place, the top step of the podium and the one slightly lower, the biggest trophy and big trophy. It's a race of speed, but even more—details. To capture the checkered flag, a top driver is key. But behind every winning driver—a team of engineers who theorize, test and tinker under the most extreme and demanding conditions. All determined to find that successful set-up and strategy that make the difference when...Milliseconds Matter.

TE Connectivity, a global technology leader of connectivity and sensor solutions, is proud to support the Andretti Formula E team and group of engineers in their quest to be the world's top electric race team. Inside every Andretti race car, and throughout the racing community, you'll find TE connectors, sensors and cables. But beyond helping electric cars reach new levels of speed, we're committed to sustainable, clean-energy innovations that will revolutionize how we live, work, play and learn. Our partnership with Andretti Technologies provides a unique platform to develop and test new technologies in a racing environment that will help Power the Future of racing and industry applications.

# REDEFINING MOTORSPORTS

**F**ormula E is a ground-breaking FIA single-seater championship and the world's first fully-electric racing series. The inaugural season began in 2014 with the series competing in 10 of the world's leading cities. Due to one team unable to compete this season, the championship sees 9 teams, each with two drivers, racing on temporary city-center circuits to create a unique and exciting race series designed to appeal to a new generation of motorsport fans.

Formula E aims to represent a vision for the future of the motor industry, serving as a framework for R&D around the electric vehicle, accelerating general interest in these cars and promoting clean-energy and sustainability.

Formula E also operates as an 'open championship', allowing teams and manufacturers the opportunity to showcase their own electrical energy innovations. Working to the technical specifications set out by the FIA, teams will focus their efforts on improving and developing powertrains and battery technology, with the aim of this filtering into the everyday electric vehicle market.

The championship centers around three core values of Energy, Environment and Entertainment and is a fusion of engineering, technology, sport, science, design, music and entertainment—all combining to drive the change towards an electric future.





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## PRACTICE

All events will open with a 45-minute practice session followed by a further 30-minute session. Drivers will have up to two cars available to them; providing the option to change cars should they wish. The drivers are able to do one 200kw qualifying simulation lap per session.

## QUALIFYING

The 18 drivers are divided into two groups of four and two groups of five by means of a lottery. Each group has six minutes during which they have to complete an out-lap, a warm-up lap at 170kw and 200 kw qualifying lap. The overall five fastest drivers then progress to the Super Pole. Spots 6-18 from the group stages determine the remaining starting grid.

## SUPER POLE

The five fastest drivers from the Super Pole go out one-by-one starting with the person who set the fifth fastest time and ending with the driver who was fastest. When one driver crosses the line to start his 200kw lap, the next driver is sent out. The order from the Super Pole determines the order for the top five places on the grid.

## EPRIX

Races will begin by a standing start (no formation lap) and last for approximately one hour with drivers making one mandatory pit stop in order to change cars. Power will be restricted to 'race mode' (170kw) but for those drivers with FanBoost, the power output can be temporarily increased. Points will be awarded using the standard FIA system (see Points).

## FANBOOST

Fans can give their favorite driver an extra speed boost (second car only) by voting for them prior to the race. FanBoost provides an extra 100kJ of energy to be used in a power window between 180kW and 200kW. This presents the three winning teams and drivers with a strategic call to make. Do they raise the power for a short boost or run at a slightly lower power for a prolonged period? FanBoost can only be used once, rather than in a series of short bursts. To cast your vote, please visit **Fanboost.FIAFormulaE.com**.

## CHAMPIONSHIP

The FIA Formula E Championship will consist of both a driver and team championship. A driver's end of season total is made up of his/her best results less one. A team's total is made up by counting all scores during the season.

# GET UP TO SPEED WITH FORMULA E

## **PIT STOPS/CAR CHANGES**

During races, drivers must make one mandatory pit stop in order to change cars. This must take place in their box and be observed by an FIA steward to ensure all safety equipment is correctly applied. A minimum time period (determined on the day) will also be enforced. Tire changes, unless a puncture, are not permitted during this pit stop.

## **POINTS**

Drivers will score points using the standard FIA system of: 1st = 25pts, 2nd = 18pts, 3 = 15pts, 4th = 12pts, 5th = 10pts, 6th = 8pts, 7th = 6pts, 8th = 4pts, 9th = 2pts and 10th = 1pt. Three points will be awarded to the driver securing pole position, while the driver setting the fastest lap receives two points.

## **TESTING**

Teams/drivers have six official pre-season test days and one in-season test. All pre-season testing takes place at Donington Park, United Kingdom. The venue for the in-season test was earlier this season in Punta del Este, Uruguay.

## **TIRES & ALLOCATION**

The Official Tire Supplier for the FIA Formula E Championship is Michelin. For each race event, each driver is supplied with four new front tires and four new rear tires, plus one front and one rear tire from the previous event.

## **CAR CHARGING**

Car charging is only forbidden during qualifying and the race, together with their Parc Ferme periods. Charging can take place during non-qualifying (practice) periods.

## **DRIVERS**

Eighteen drivers, from 9 teams, will compete in the 2015/2016 FIA Formula E Championship.

# TECH TALK

The orange TE Test Car is used for technological modifications and improvements, as well as a harsh environment test bed. The blue Amlin sponsored car is the race car used during race weekends. Over 100 TE products are in all Andretti Formula E cars.

## TE PRODUCTS IN THE CAR

TE Autosport terminals & connectors

TE Automotive terminals & connectors

Raychem wire, cable, connector boots & heat-shrink tubing

TE Sensor Solutions

## RACE CAR DIMENSIONS

Overall length	5000mm (max)
Overall width	1800mm (max)
Overall height	1250mm (max)
Track width	1300mm (min)
Minimum weight (inc driver)	888kg (batteries -350kg)

## POWER

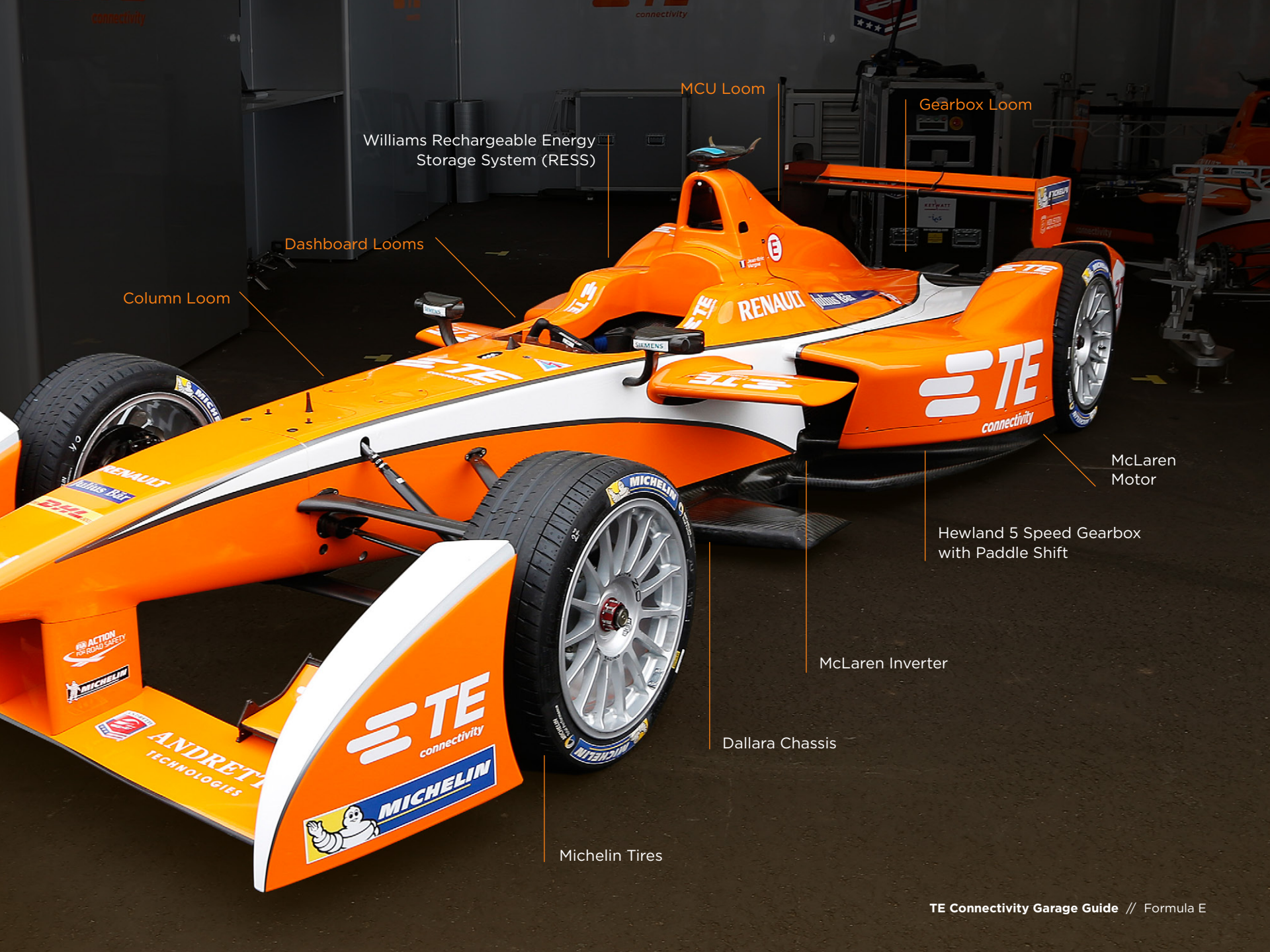
Qualifying power	200kw (270bhp)
Race power	170kw (225bhp)
FanBoost (race-only) (40.5bhp)	Temporarily increases max power by 30kw

## PERFORMANCE

Acceleration	0-100 km/h (0-62 mph) in 3.1 sec
Maximum Speed	225 km/h (140 mph)
28 kWhr RESS	Lasts around 22mins at race power
Car Noise	Limited to 80 dB (normal passenger car is 70 dB & Formula 1 car is upwards of 130 dB)







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MCU Loom

Gearbox Loom

Williams Rechargeable Energy Storage System (RESS)

Dashboard Looms

Column Loom

McLaren Motor

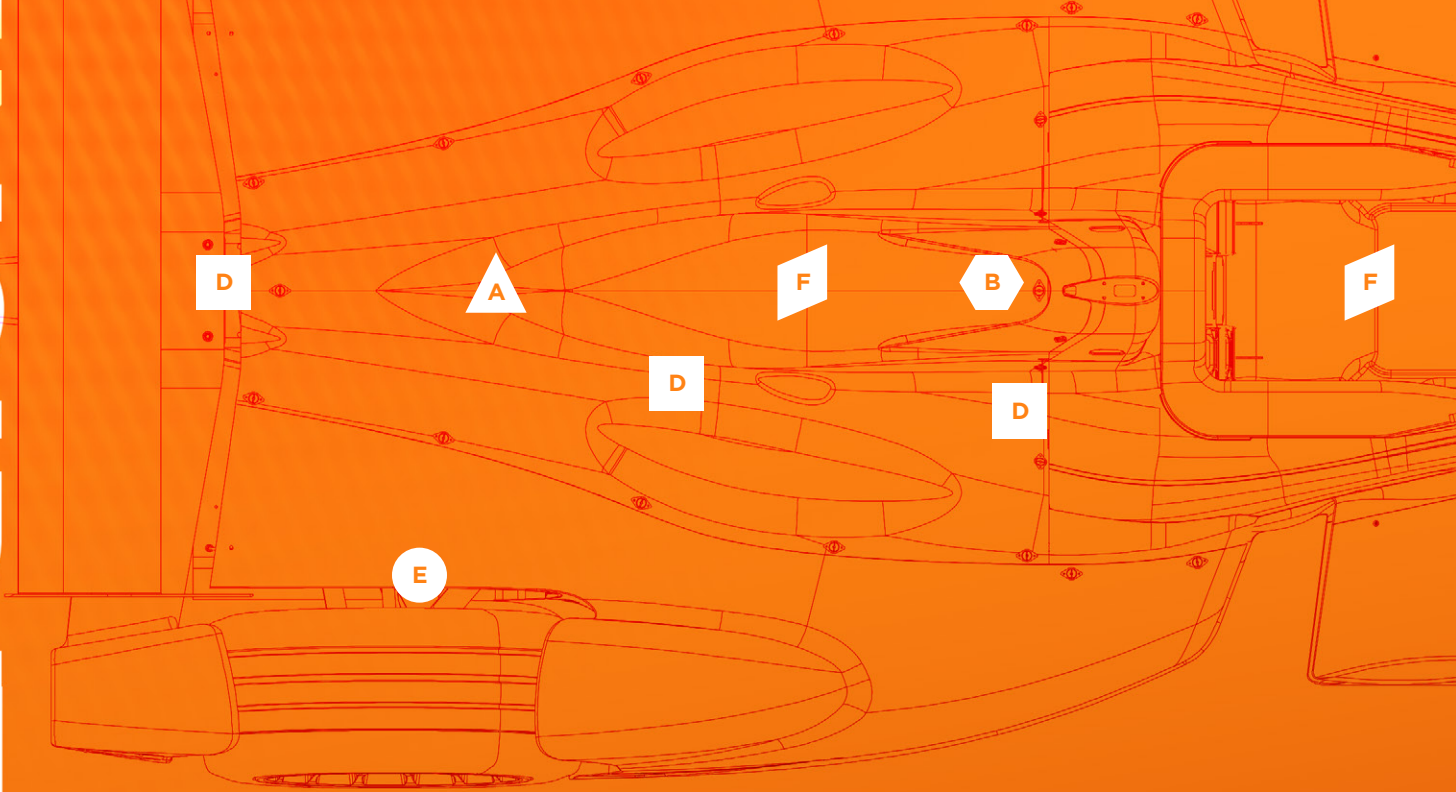
Hewland 5 Speed Gearbox with Paddle Shift

McLaren Inverter

Dallara Chassis

Michelin Tires

# INSIDE THE CAR

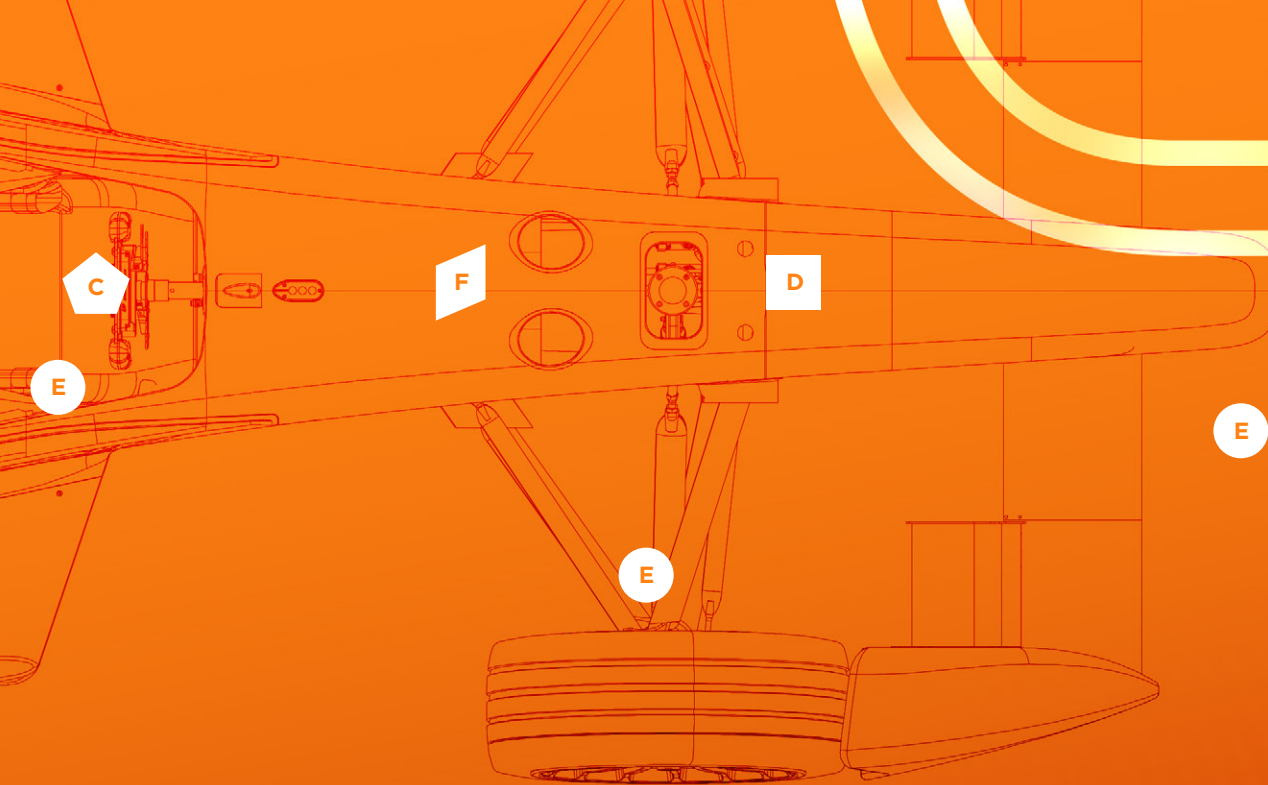


## **A** ELECTRIC MOTOR

For season 1 of Formula E all cars ran an electric motor built by McLaren Applied Technologies. This motor was originally designed for the P1 Supercar. A typical hybrid motor found on a road-car produces 3kw/kg, but the motor used on the Formula E car produces 8kw/kg which is 3-4 times higher. Already plans are in place to increase this further in future seasons. The motor is located behind the battery, just in front of the rear wheels of the car. The motor weighs 26kg and operates in re-generation (charging) mode for around 10% of a race.

## **B** BATTERY

The Battery or Rechargeable Energy Storage System (RESS) is situated just behind the driver and built specifically for Formula E by Williams Advanced Engineering. The battery weighs a mighty 350kg and has a power output of 28kw/h. For season 1-4 the battery powers the car for half the race distance, but by season 5, technology will have moved on to allow a single battery to run the whole race distance. The batteries are liquid cooled to optimize performance in harsh charging and discharging conditions. 2 Deutsch Autosport connectors allow Williams to monitor the condition of the battery at any time the car is running.



### **C** STEERING WHEEL

The steering wheel allows the driver to change the setup of the car during the race. There is a braking control that allows different levels of battery re-generation during the race, a torque setting that controls how the energy is delivered to the electric motor, and a map control which the team uses to implement its strategy in terms of power use for the race. There is also a radio button, pitlane speed limiter and a couple of buttons to change the display. All this allows the driver to optimize the car making sure the energy is used at the right time for the best race result.

### **D** DEUTSCH AUTOSPORT ASL

The Deutsch Autosport ASL (Microlite) connector is the most used connector type on the car. It's used in all the areas where sensors need to be connected to the main electrical harness on the car. The ASL connector has 5 gold plated contacts to connect the Raychem 55M wire for maximum performance with light weight. The ASL connector was introduced to motorsport in 1999 and is the most widely used sensor connector in world motorsport.

### **F** RAYCHEM 55M WIRE

TE Connectivity's Raychem 55M wire is the first choice of professional motorsport in the world today. It is very strong and light-weight and is able to work in -65C to +200C conditions. The whole electrical system on the car is connected with 55M and requires about ½ km of wire in total for all the systems. Several electrical harnesses using 55M are used on the car—the main chassis harness, the gearbox harness, and the cockpit harness. All perform critical functions and need to operate in high heat and vibration in racing conditions.

### **E** DEUTSCH AUTOSPORT ULTRALITE

The ASU connector was introduced to global motorsport after ASL in 2003. It comes in either 3 or 5 contact versions and performs a similar job to ASL, connecting sensors to the electrical system on the car. The version used on the Formula E car is the 3 contact version. Typically sensors have a power, signal and ground (3 wires), so ASU is ideal for this task.



## SIMONA DE SILVESTRO

Simona de Silvestro joined the single-seater ranks in 2005 competing in Formula Renault Italy. She then made the switch to Formula BMW in the US ending the year in an impressive fourth in the overall standings.

The highly-rated Swiss driver turned heads in the Champ Car Atlantic series and later in her debut season in IndyCar when she was named 2010 'Indianapolis 500 Rookie of the Year.' Further success followed as Simona became the first woman to claim a road course podium in 2013, collecting the second placed trophy at the Grand Prix of Houston.

A year testing with the Sauber Formula 1 team was followed by Simona's return to IndyCar racing in 2015 for the Indianapolis 500 with Andretti Autosport and TE Connectivity.

She is the only female driver in this season's Formula E and drives the No. 28 Amlin Andretti Spark\_SRT 01.



## ROBIN FRIJNS

Robin Frijns, like many of his competitors, progressed through the single-seater ranks from an early age and won titles in a number of junior categories including Formula BMW Europe, Formula Renault 2.0 Eurocup and the 2012 World Series by Renault 3.5.

The Dutch driver and GP2 race winner has been recognized for his talent throughout his career testing for both Sauber and Red Bull Racing at a Formula 1 young driver test in Abu Dhabi.

In 2013, Robin joined Sauber as an official test driver and took part in a partial season of GP2 picking up one victory and two podium finishes. Frijns later joined Caterham F1 as a test driver in 2014.

Last year he won multiple races in the Blancpain Sprint GT series. In his first season in Formula E, he drives the No. 27 Amlin Andretti Spark\_SRT 01.



As the lead partner of Andretti Technologies, TE Connectivity has a rotational engineer program that puts one of TE's automotive engineers inside the Andretti Autosport shop in Indianapolis, Indiana (USA). The resident engineer is responsible for advanced engineering expertise—finding new ways to improve the Andretti Team's performance and co-creating and testing new TE products in the harsh environment of race cars.

Prior to becoming the Resident Engineer, Ishin Ueyama was a field application engineer for TE's automotive business. He worked directly with OEMs and Tier 1

customers to develop the best sensor solutions for their specific applications. Hailing from Japan, Ishin graduated from Drexel University in Philadelphia, Pennsylvania (USA) where he was part of Formula SAE. During his senior year, he entered the Shell Eco Marathon Challenge where he and his peers placed first in the competition

Ishin's current projects with Andretti Technologies include aluminum wire harnesses, fiber optics and sensors. Follow his blog and the technological advancements at [TE.com/Racing](https://www.te.com/racing).

# CO-CREATING THE FUTURE

