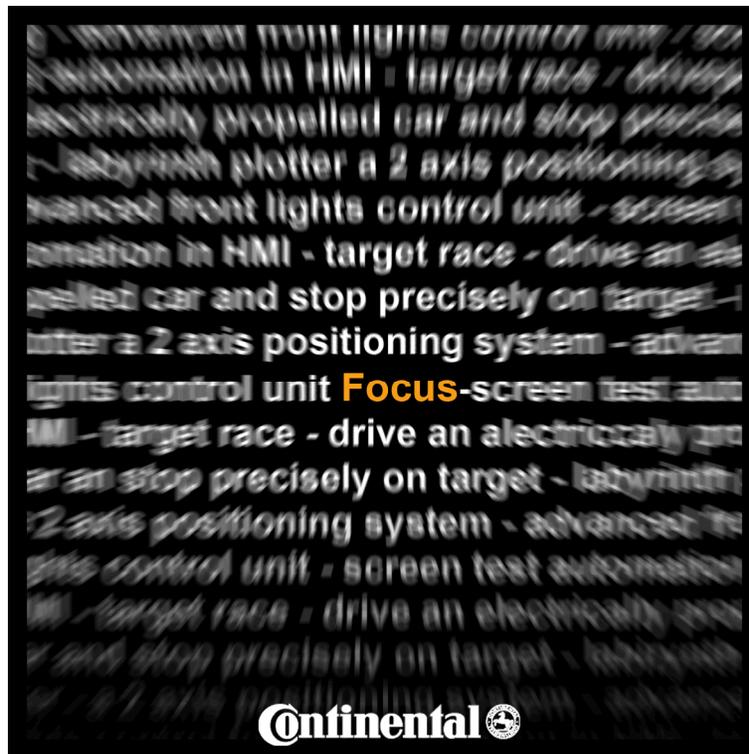




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Powertrain - Target Race - drive an electrically propelled car and stop precisely on target

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1 System Overview

The system has two big parts:

- **Brushless Motor with Power and Control modules**
- **Power train components (chassis, differential/gears, wheels)**

Brushless motor:

Motor characteristics	Values
Dim. (Diameter x length)	24 mm x 38 mm
Threaded mounting distance:	16 mm
Speed:	5000 rpm
Idle Speed:	5000 rpm
Idle Current:	1.2 A
Maximum current:	20 A
Shaft Ø:	2.3 mm
Load current:	15 A
Cells NiCd / NiMH:	7 to 10
Cells LiPo:	2 to 3
Operating voltage:	7.4 - 12 V
Turns:	--
Weight:	53.3 g



Figure 1-1 Brushless Motor picture

Power Module and Control module will be developed by each Open Doors Team. All motor parameters must be considered for electric system design.

Power train system will be developed by each Open Doors Team. All motor parameters must be considered for electric system design.

2 System Functions

Specifications:

S1: Each car will run on a predefined race track with 5 m length and 1 m width, made from rubber.

S1.1: The STOP line is placed at 75% of a positive slope with the length of 1 m and an angle of 18 degree.

Obs. From S1 and S1.1 results a track with 4.25 m of plane track and 0.75m slope until stop condition and an additional 0.25m of slope after stop condition.

S2: In the same time, only 2 cars are allowed on the race track.

S3: For each car, limitation bars are mounted on track to allow only straight forward displacement (no steering is need)

S4: The distance between car limitation bars is adjustable with car width.

S5: The starting point is marked on the race track by a green line (or chess type start line).

S6: The end point is marked on the race track by a red line.



S7: A basic drawing with race track is shown below.
 S8: The car must be independent. The battery must be carried by the car.
 Info: Number of wheels is not fixed.



Requirements:

- R1: From stand still position, on predefined track, the car STARTS by pushing a START button available and easy accessible on the car.
 - R2: Each car must run without any steering device, straight.
 - R3: During cruising, between START and STOP line, no intermediate stops are allowed. (No civil to pass).
 - R3: For stopping the car, no sensors must be use. The STOP condition must be reached by using track information (distance, speed, acceleration, etc).
 - R4: The braking is done using only electric motor control functions, no additional mechanical brakes are allowed.
 - R5: When the car is lifted up from the track, during cruising, the car wheels must stop in less than 3 sec. Here a sensor can be used, but a solution without sensor is better rewarded.
- Stall protection shall be implemented for time > 500 ms**

Condition to WIN:

The evaluation will be done in two phase:

1. In the first phase, all preconditions from table below must be fulfilled and overall points must be ≥ 24 . If nobody reaches 24 points, the winner is established in this phase, and who gets more points, win.
2. If phase 1 is closed, competitors that have 24 points or more are submitted in the final tournament.
 - a. The final tournament is a pyramidal style tournament, with elimatory rounds.
 - b. The round is a one to one race between 2 players.
 - c. Each round has 3 stages, each containing 1 track length race.
 - d. The closest car to the red STOP line will win.
 - e. The fastest car that reach the STOP, win.
 - f. The "closest and fastest" criterions are considered using a combined formula. The idea is to reach the target in lower time than opponnet. The formula used to establish the race winner, will be provide in a future project step.
 - g. During cruising, between START and STOP line, no intermediate stops are allowed. In the car stops, this will be considered as STOP line.

The preconditions will be evaluated before tournament.

Precondition test	Description	Points	Fail/Pass
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HW Design	The system must contain manufactured Inverter and Control Board 2 – Inverter design, hardware protections are evaluated, 2 - Control board design is evaluated		4	To pass, 2 points must be achieved
SW Design	The SW motor control loops are evaluated: Current loop: 1 Torque loop: 2 Speed loop: 2 Overall performance control structure evaluation (observer, prediction):3 A Specification Design Document will be provided by each team where description of SW implementation is done.		8	To pass, at least 4 points must be achieved
Power Train	The motor must be integrated in a power train system. (Similar to a car toy) 12 – Level of mechanical design, inventively, robustness, wheel cornering for bar limitation avoidance		12	To pass, 8 points must be achieved
Forward	The motor must run in forward direction		2	To pass, 2 points must be achieved
Reverse	The motor must run in reverse direction		2	To pass, 2 points must be achieved
Brake	The motor must stop without mechanic brake		2	To pass, 2 points must be achieved
Lift up	When the car is lifted up from the track, during cruising, the car wheels must stop in less than 3 sec	Senseless	8	To pass, 4 points must be achieved
		With sensor	4	