



**NXP CUP**  
INTELLIGENT  
CAR RACING

# **The NXP Cup**

## **2016-2017 EMEA Rules**

**The spirit of the game is that students demonstrate excellent hardware integration and superior programming.**

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## 1. Enrollment Requirements

1. Teams must register in the online system to participate.
2. Three person maximum team size, minimum of two.
3. Team members must be students. Team members might be a mix from high school, undergraduate or graduate program. A team may have only one graduate student on a team. However, if a graduate student is included on a team, the team must have three students where the other two students are high school or undergraduate.
4. Teams with High Schools students can choose to be involved in the High School Challenge (other rules) or University Challenge
5. Team members can be part of a student club, robotics club, STEM association.
6. Team members might be from different schools, universities, association or club.
7. Validation of the eligibility of the students (high school, under-graduate or graduate) will be done through the registration process. Students may be asked to provide proof of student status to access the qualification events.
8. It is recommended that every team have a faculty advisor. If a team chooses not to have one, they must designate a team member as team advisor for receiving racing notifications
9. Cars will be designed and constructed by students ONLY.
10. Participants, advisers, and audience are expected to exhibit good sportsmanship. Any inappropriate behavior or cheating may result in disqualification.
11. Enrolled teams agree to share their technical reports on communities as described in this document in the sections below.



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## 2. Equipment Requirements

Each team shall use the same basic kit of parts as described below. The following requirements are in place to keep the playing field level. If any standard component of the car model is damaged, then a replacement part of the same model should be used.

The original and unaltered equipment must be used as the entry. This includes:

1. Outer tire treads and rim
2. Drive - DC motors. (See "The Freescale Cup Knowledge Center" for detailed description---<https://community.freescale.com/docs/DOC-1284>)
3. Transmission Ratio of Drive Motor (TFC-Shield)
4. Servo Motor-Futaba S3010 (See The Freescale Cup Knowledge Center for detailed description)

Here the allowed mechanical modifications and restrictions:

1. You may not change the wheel base (distance between wheels)
2. No part of the car shall exceed dimensions of 250mm/9.85in (W) x 400mm/15.75in (L) x 305mm/12in (H)
3. You may drill holes and mount auxiliary pieces on the chassis assuming it is contained within the above dimensions.
4. You may change the orientation of the servo motor and related linkages.
5. You may add a "skin" to the car but it must be removable during inspection.
6. You may adjust or remove springs, linkages, and other non-essential pieces.
7. You may adhere the tread to the rim of the wheel.



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The participants must provide the battery. The electrical restrictions are:

1. 7.2V,  $\leq 3000\text{mAh}$ , rechargeable NiCd, NiMH or Li-ION.
2. Only one (1) battery at a time may be used to power the vehicle and any attached hardware

Students may create custom boards in addition to the boards provided in the default kit.

Any board modification or creation must follow the same rules as stated below and provide a detailed technical report including Bill of Material (BOM), layout and reasons for using a different board than the ones provided as default.

The restrictions for modifications or creation of new electronics are:

1. The default camera can be changed within the limits of the authorized hardware listed on the NXP Community
2. A Freescale 32-bit Microcontroller must be used.
3. One processor - No auxiliary processor or other programmable device allowed.
4. The car must use an optical sensor to navigate, no other navigation technique is to be used
5. DC-DC boost may not exceed battery voltage.
6. Total capacity of all capacitors should not exceed 2000  $\mu\text{F}$



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You can add up to 16 sensors on the car. NXP sensors must be used. Please contact your local contact in case of questions or doubts.

Examples of sensors are:

1. IR Transmitter/Receiver pair is 1 sensor
2. A CCD sensor is 1 sensor
3. The provided Line Scan Camera is 1 sensor
4. A Hall Effect sensor on two rear wheels is 2 sensors
5. An encoder mounted on one wheel is 1 sensor

### **3. Technical Reports**

Each team is to provide a technical report prior of the each event (qualification, regional finals). The technical report has to be sent to the organizers at least 14 days before the event via email as PDF file

**By enrolling into The NXP Cup, team members agree that NXP will post the technical reports after the completion of the event.**

The posting of the reports of the teams that are qualified to go to the next level of challenge will be delayed until their final report for the final race.

The technical report must include information about the racecar, its properties and specifications. Any modification or addition to the starter kit from The NXP Cup must be documented with:

1. Schematics
2. Bill of Material
3. Reason for the change from the starter kit
4. Specific performance parameters for the change/addition



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## 4. Vehicle Inspection

Before the race, the judges will perform a technical inspection of all entries. This includes vehicle specifications, dimensions, and equipment requirements listed in this document.

1. All cars must be placed in the Inspection area on or before the designated time.
2. Once in the Inspection Area, you may not touch car until you are called to race. The car can only be removed from the Inspection Area upon approval from the race management. No repairs or modifications can be made on the Inspection Area.
3. The judges might request to check the software used on the vehicle and to reprogram the microcontroller at this time.

In the event of any violations, the organizing committee is entitled to disqualify the corresponding team.

## 5. Timed Race Procedure

The Race order will be determined by a random drawing.

When your team is called, one (1) team member may remove the racecar from inspection area and has two (2) minutes to prepare the car. These following actions are allowed during the preparation time:

1. Configure parameters via on-board interfaces. (Switches, Knobs, etc.)
2. Alter the angle of your camera
3. Change batteries
4. Clean the wheels

It is not allowed to connect the racecar to any computer devices to upload, reconfigure or change any part of the programming on the racecar.



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Only one (1) team member is allowed on the racetrack area during the race procedure.

Before the 2 minutes expire you must signal “Ready” to the referee before starting car.

After the referee confirms “Ready”, the vehicle should leave the starting area within 30 seconds.

The team has three (3) attempts to complete one (1) lap. The first (not the best) completed time will be recorded. For example

5. Attempt 1 – Vehicle goes too fast around a curve and goes off track. Time is not recorded.
6. Attempt 2 – Vehicle makes it around track successfully. Time is recorded.
7. Attempt 3 – Is forfeit because FIRST time (Attempt 2) has been recorded.

After each attempt the same team member has two minutes to make approved adjustments to vehicle.

Once all the attempts have been done or the team has recorded a time, the team member must return the vehicle to inspection area.



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## 6. Race Day Schedule

The event usually runs during 1 day for qualification races and 2 days for regional finals.

The typical schedule is:

1. Practice Time: prior to final race, a test track will be available. Final calibration may be made at this time. This will be organized with team slots and/or “free-time”.
2. Reconfigure practice track to final track.
3. Vehicle Inspection (see section 4)
4. Timed Race
5. Communication of qualified teams
6. In the case of EMEA Finals: Awards Ceremony
7. Conclusion of the event

## 7. Event Personnel

**Organizing committee-** A committee of NXP people (organizers, engineers, HR) will coordinate event day activities and mediate and resolve any disputes.

**Referees-** Responsible for on-track activities. This includes race track management such as starting and stopping vehicles, as well as timing and scorekeeping. Comprise up of faculty, student, and/or NXP and industry employees.

**Judges-** Interpret and enforce rule compliance. This will be comprised of NXP employees and members of contributing industry sponsors.

***Event Personnel shall not aid any one specific team. Communication shall be open to all teams and shall not disclose any information that might compromise the fairness of the competition.***



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## 8. Fouls, Failure and Disqualifications

NXP and the organizing committee of the event will interpret the rules as needed in case of conflict.

**Foul** is a minor infraction, which results in time penalties.

**Failure** results in the current attempt lap time not recorded.

**Disqualification** is a major infraction that no result times will be recorded

During the race, referees will determine whether the racing car ran out of the race track and assign time penalties.

Any of the following conditions qualifies as a **foul** and result in time penalty added:

1. The racecar fails to leave the starting area within 30 seconds after beginning of the race [+1 second].
2. The racecar fails to stop 2 meters/6 feet or leaves the track after crossing the finish line [+1 second]
3. The racecar exits the racetrack after crossing the finish line [+1 second]



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Any of the following conditions qualifies as a **failure** and no race time is given:

1. Three or more wheels leave the race surface
2. The racing team fails to get prepared for the attempt within the two (2) minutes allotment
3. The team member handles/touches the racecar after the technical inspection without consent of the referee.
4. The racecar fails to reach the finish line within 120 seconds after leaving the starting area.
5. The team member touches the car at any time between start and finish as "Start" is once part of the racecar crosses or partially crosses the starting line and "Finish" once the vehicle crosses the finish line.

Any of the following conditions qualifies as a **disqualification** and all registered times will be nullified

1. Any off track equipment or behavior that may influence or impede cars
2. Doing a Disallowed Modification any time after the technical inspection
3. More than one team member in the race field
4. Any cheating during the competition
5. Failure to pass the technical inspection

Equality and fairness is ensured as much as possible on the condition of actual feasibility. Disputes will be resolved by a vote of NXP, members of the organizing committee, and judges.



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## 9. Timing/Scoring

1. Time is captured using an electronic gate and/or handheld timer.
2. Time starts and ends when the first part of the racing car breaks the start/finish line.
3. Fouls will result in the time addition to the car's lap time.
4. Disqualifications and Failures will result in no score.

## 10. Parameters of the Racing Track

1. A test track made from the same material as the final track will be made available on the day prior to or before the final race for calibration and design modifications.
2. The actual layout of the final racing track will be unknown to competitors until competition day.
3. Width of the racing track shall not be less than 600mm/23.65in.
4. Material and dimensional specifications can be found on the community.
5. Surface of the racing track is matte white, with a continuous black line (25mm/1in wide) on each edge of the track.
6. The racing track can intersect with a crossing angle of 90°.
7. The racing track can have inclines, declines and tunnels.



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***The rules and conditions are subject to change by NXP if necessary. NXP reserves the right in their sole discretion to cancel, suspend and/or modify The NXP Cup race at any time.***

***These official rules are drawn up in the English language. If these official rules are provided in any other language and there is a conflict in the text, the English language text shall prevail.***

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