The NXP Cup Official Rules

Season 2023/2024

Version 1.1

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Contents

1. Introduction

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

The NXP Cup 2023/2024 is a brand-new season focused on simplifying the challenge to allow students to focus on learning, fun and great performance. All legacy Model-C, Alamak and DFRobot cars are allowed as well as any other car kit if the electronics are within the rules. Participants can use the broad range of NXP's technology solutions including MCUs, MPUs and Sensors.

Also, regardless of the board(s) and electronic configuration of the car, car size, motor type, all teams will compete in the same group.

2. Conditions of Enrollment

Teams must register online to participate. The registration opens in October and closes in January 2024. Link to registration can be found on www.nxpcup.nxp.com

- Team member count must be 1 (one), 2 (two) or 3 (three)
- Each team member must be a student from a registered school or can be member of a robotic club or a STEM Association. Students enrolled into the challenge can be in any field of study.
  Students of all grades can team up as they wish as long as the number of students per team is within the rules. Team members can be a mix from middle-school, high school, undergraduate or graduate program or all the same group
- All registered teams will compete in the same race regardless of the education grades of the students composing the team
- Team members might be from different schools, universities, associations or clubs
- Validation of the eligibility of the students (middle-school, 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
- It is recommended that each team have a faculty coordinator. If a team chooses not to have one, they must designate a team member as team coordinator for receiving racing notifications
- It is forbidden for non-student support team to build and program the racing car

- Participants, advisers, and audience are expected to exhibit good sportsmanship. Any inappropriate behavior or cheating may result in disqualification
- Teams are allowed to register more than one race car into the race. If such, each car must have a different team name at the time of registration. Cars must be running on different MCU or MPU board to qualify.

3. Equipment Requirements

Each team shall use a car kit and boards as described below. Some changes are allowed. 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.

Participants can use:

- An existing NXP Cup car kit (NXP Cup Buggy, DFRobot model 2019, 2020, Model-C or Alamak)
- Acquire a commercial kit (recommended scale 1/18)

Build their own kit (example: 3D-Print, wood laser cutting, Lego…)

For all car kits, the following requirements must be respected:

- The car can be propelled by up to 2 motors, brushed or brushless. When 2 motors are used, they can be on the same axle (one motor for the right wheel, one motor for the left wheel) or each on a separate axle (one motor for the front axle, one motor for the rear axle)
- The car must have maximum 4 wheels. Tricycles or 2-wheels balancing vehicles are allowed into the challenge
- Participants are allowed to use any NXP MCUs or MPUs (such as i.MX) or even the combination of the two. All boards must be NXP brand boards or powered with an NXP brand MCU / MPU. Students may create custom boards in addition to the boards provided in the default kits
- The recommended computing unit for the NXP Cup car is the RDDRONE-FMUK66 as it is compatible with the HoverGames challenge and it is documented for usage with the Gazebo Simulation tool

- Any board modification (from a purchased board) or creation must follow the same rules as stated below and provide a detailed technical report including Bill of Material (BOM). The restrictions for modifications or creation of new electronics are:
- The default camera can be changed. Any camera used must either be equipped with a NXP MCU / MPU or no embedded MCU / MPU at all (direct connection to the MCU/MPU board via SPI). Recommended camera NXP powered camera is Pixy2 camera (https://pixycam.com/pixy2/)
- The MCU(s) and/or MPU(s) on the board must be of NXP brand. More than one processing unit can be used on the car
- The car must use an optical sensor (camera) for primary navigation. Additional sensors can be used to improve the management of the surroundings of the vehicle
- The car must be autonomous and cannot be remote controlled. During the race and the challenges, the car cannot be fitted with any wireless connectivity. Connectivity is allowed only during training sessions to help monitor the vehicle and run diagnostics during the development but must be removed from the vehicle during the official challenges and races
- Participants can add up as many sensors as they want on the car. NXP sensors must be used when such sensors are available into the NXP product line card. Please consult Mouser.com or consult with the NXP Cup Management team in case of questions or doubts. Here are some examples of sensors that can be used:
    - IR transmitter/receiver
    - CCD sensor
    - Hall effect sensor (one per wheel)
    - Encoders
    - 3-axis sensors
    - Optical sensors
    - Ultrasonic sensors
    - Gyroscope sensor
    - Lidar sensor

- If required, participants can add a commercial Electronic Speed Control (ESC) module to help manage motor performance. When an ESC is selected, information and specifications must be added to the Log Book.

- Battery requirement:

    - Only 1 (one) battery can be used to power the vehicle and any attached hardware

    - rechargeable NiCd, NiMH or Li-Ion with a maximum rating of 6000 mAh

    - LiPo (Lithium Polymer) batteries can be used but are limited to 3s models (3 series of cells) 11.1 V maximum rating of 6000 mAh

    - LiPo batteries are allowed but participants must ensure they travel with LiPo special and authorized packaging. A separate area for battery charging will be created during the NXP Cup events. LiPo batteries can be charged only in the specific and designated areas. Batteries must be moved to the garage and race floor only in the approved safety packaging. Careful: special regulations are in effect for traveling with LiPo batteries. Consider verifying those conditions to be able to attend the racing events before acquiring your kit and batteries (see FAA rules)

There is no size limitation on the car kit however, it is highly recommended to ensure that the chosen car kit can handle the turning radius of the track to respond to the requirements of the challenge. Recommended vehicle scales are 1/18. Please also check the NXP CUP track dimensions to ensure your vehicle can pass steeper curves.

The rules apply to all vehicles entered into the challenge regardless of their make or size. No exception will be granted.

The car kit and electronics used to manage the race car are interchangeable. Participants can decide to use a purchased, 3D-printed, Model-C or an Alamak kit with any NXP-approved electronics. For Model-C and Alamak, the original electronic boards supplied with those kits might no longer be available, participants can opt for new NXP-approved boards or use the MikroE/HE-ARC Ingenierie KL-25Z-based board as communicated in the NXP Cup newsletters and listed on the NXP Cup community. We recommend the RDDRONE-FMUK66 for any new car kit design or implementation.

4. Support structure for the NXP Cup

The following locations are available for technical and program support to all the participants:

- A Gitbook has been created to help support participants into the challenge
- A discord server is implemented to serving as a communication and exchange hub.

5. Vehicle Technical Inspection

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

All cars must be placed in the inspection area on or before the designated time prior of the timed race.

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.

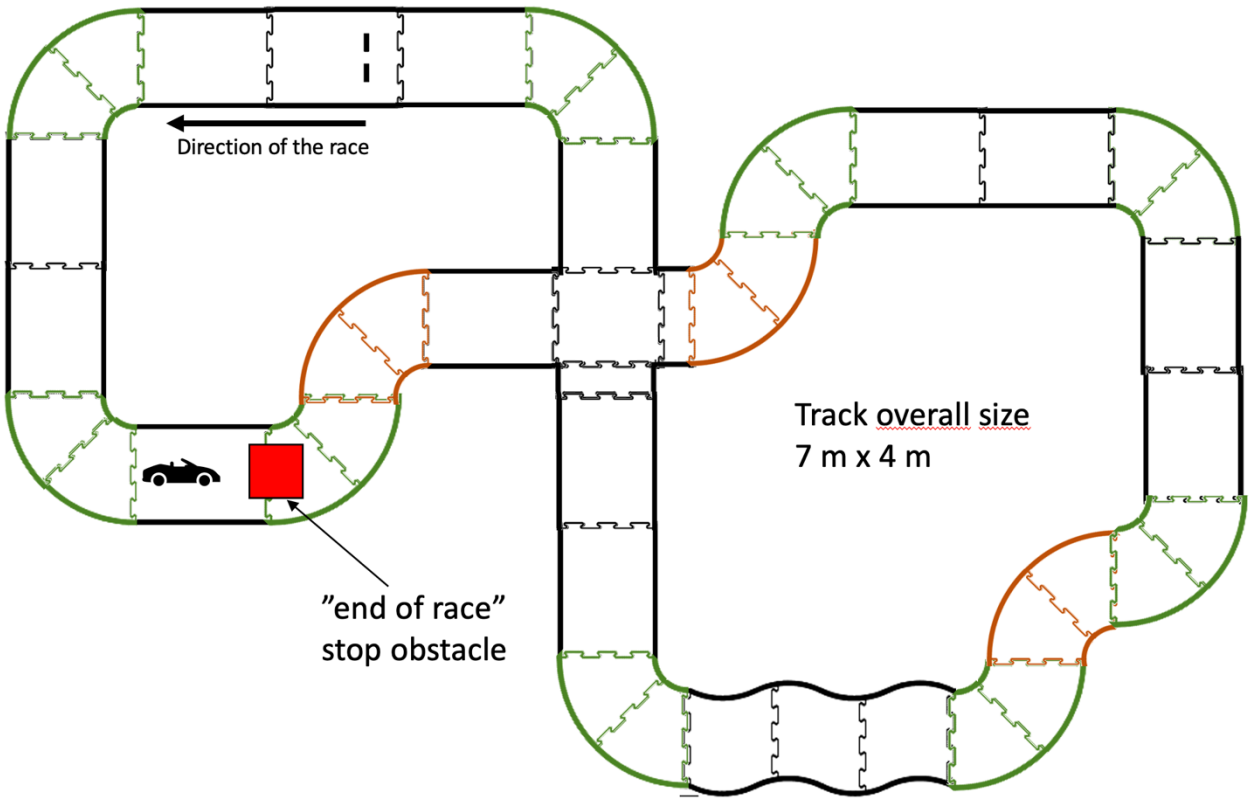
The judges might request to check the software used on the vehicle and to reprogram the MCU or MPU at this time.

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

6. Racing procedure

The timed race includes speed, precision, and reliability. Once the car has started on the racetrack and passed the 2 first curves, an “end of race” stop obstacle is placed on a straight section of the track.

The racecar must pass the end of race start/stop sign, significantly lower its speed, and continue to drive until stopping within 15 cm, without touching, of the white obstacle that has been positioned somewhere on the racetrack.



Above: Example of event racetrack layout

The “end of race” stop obstacle is a white cube (made from Styrofoam or similar) with dimensions of 20x20x20 cm placed in the middle of the racetrack once the car has done the initial pass during its 1st lap.

The race start order will be determined by a random drawing. The random order is to be communicated before the race to the participating teams for the on-campus event.

The track layout will be communicated only 60 minutes prior to the event by the event organizers at the campus. No training on the disclosed track layout is allowed.

The teams will race on the same racetrack layout regardless of car model and team members’ composition education grades.

When the 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:

- Configure parameters via on-board interfaces. (Switches, Knobs, etc.)
- Alter the angle of the camera
- Change the battery

- 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.

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

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:

- Attempt 1 – Vehicle goes to fast around a curve and goes off track. Time is not recorded.
- Attempt 2 – Vehicle makes it around track successfully. Time is recorded.
- Attempt 3 is forfeited because FIRST close loop tine has been recorded (in attempt 2)

After each attempt, the same team member has two (2) minutes to make approved adjustments to vehicle.

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

1) The event is scheduled in agreement with the NXP Cup EMEA organizing team
2) The event should be organized over a 1-day period to help with the organizational logistics of the event
3) Teams are allowed to test their cars on test tracks in the room in which the main event will be organized. Team members can attend the training session at the same time on the following tracks:
    a. Test track for end of race stopping
    b. Speed test track(s) with timing system installed
4) 60 minutes prior of the start of the timed race event, all team’s cars must be put into technical inspection for compliance with the rules
5) All students and team members are asked to leave the event room premises

6) 60 minutes prior of the start of the event, the NXP Cup's organizing team provides the university organizing team with the layout of the timed racetracks to be built

7) Once the tracks are built, teams are allowed to enter the room but cannot access their cars to test

8) The procedure for the timed race is followed by NXP CUP Management

9) Final scoring is done based on the scoring system documented into these rules.

7. Timing/Scoring

The timed race lap time is captured using an electronic gate and/or hand-held timer. Time starts and ends when the first part of the racecar passes the start/finish line.
Fouls will result in the addition of the penalty time in addition to the car's lap time.

8. Scoring procedure

A scoring spreadsheet will be provided for each event to document the performance of the participating teams.

The final scoring will be done when all videos and results from each events are received by NXP (in case of yellow flag corona status). The champion team is the one that accumulates the highest number of points.

That score will be added to the score of the timed race based on the following ranking:

Fastest time	2nd fastest time	3rd fastest time	4th fastest time	5th fastest time	6th fastest time	7th fastest time	8th fastest time	9th fastest time	10th fastest time
650 points	550 points	450 points	400 points	350 points	300 points	250 points	200 points	150 points	100 points

The bonus of 150 points for slowing down and stopping within 1 meter in front of the "end of race" stop obstacle is added to the points for each team if applicable.

In case of parity in points between more than one team, the winning team is the one that has the fastest time on the speed race. Only one team will be crowned the NXP Cup EMEA Champion.

9. 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 racetrack and assign time penalties.

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

- The racecar fails to leave the starting area within 30 seconds after beginning of the race [+1 second].

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

- Three or more wheels leave the race surface
- The racing team fails to get prepared for the attempt within the two (2) minutes allotment
- The team member handles/touches the race car after the technical inspection without consent of the referee
- The race car fails to reach the finish line within 120 seconds after leaving the starting area
- 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 scores will be nullified:

- Any of track equipment or behavior that may influence or impede cars
- Making modification to the racecar any time after the technical inspection
- More than one team member in the race field (for the timed race)
- Any cheating during the competition

- Failure to pass the technical inspection

Equality and fairness are 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.

10. The Race Track

Test tracks can be laid from track elements unused on the communicated racetrack in an adjacent room with similar lighting conditions (2nd classroom). The actual layout of the tracks for the Obstacle Avoidance Challenge and Timed Race are unknown to the competitors the time of each challenge. The racetrack specifications are as follow:

- The width of the race track is 55cm
- Material and dimensional specifications are listed here
- Surface of the racetrack is matte white with a continuous black line (2cm) on each edge of the track
- The racetrack can intersect with a crossing angle of 45° and 90°.

11. Event Personnel

A committee of NXP people (organizers, engineers, HR) will be on contact with the on-campus organizers during the on-campus event to help with event coordination and mediate and resolve any disputes.

The NXP Cup organizing team will name on-campus referees. They are responsible for on-track activities. This includes racetrack management such as starting and stopping vehicles, as well as video recording, timing and scorekeeping.

The Event Personnel shall not aid or give favors to 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.

12. Contact Information

The organizing team is composed of the following persons:

Garance Aubert-Mazenq: garance.aubert-mazenq@nxp.com

Monica Tudora: monica.tudora@nxp.com

Walid Ksiri: walid.ksiri@nxp.com

13. Legal Clause

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.