The NXP Cup Official Rules

Season 2020/2021

Version 1.0 updated version updated 10 December 2020

The NXP Cup Rules 2020/2021 EMEA Rules

Contents

1. Change log

The change log gives you an executive summary of what have changed compared to the NXP CUP 2019/2020. Read carefully all the rules throughout:

- Participants of the 2019/2020 season are allowed to sign in and participate into the 2020/2021 season regardless of their student status
- You can register solo, meaning participating with 1 person only

- NXP Cup participants must register into the NXP Cup registration system AND in the Electromaker.io project platform to have a valid full registration into the challenge

- Management of the COVID-19 pandemic situation of the moment might impact participants' attendance and participation at NXP Cup EMEA events such as qualifications and finals. A special 2-levels security ranking as been created to help evaluate and answer to the participants about possible restrictions, delays or cancellation of events.

    - Level Yellow: limited events will be organized at universities/schools that count more than 5 home-teams. Limited evaluation of performance will be done via video recording of the events. The Obstacle Avoidance and the Speed Race will be used to evaluate the performance of the teams. Not all registered teams will be able to show their work, but all teams will be evaluated for a chance to win the "Creativity and Design Award" based on the project documentation loaded into the Electromaker.io platform.

    - Level Red: all events are cancelled; all teams will be evaluated for a chance to win the "Creativity and Design Award" based on the project documentation loaded into the Electromaker.io platform

2. Introduction

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

The NXP Cup EMEA 2020/2021 is a brand-new season focused on opening up the rules to allow students to source their car kits where they think best fits their need. Legacy Model-C and Alamak cars are allowed as well as any other car kit as long as the electronic 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.

3. Situation with the COVID-19 pandemic

Safety of the participants and supporting teams are at the center of the attention of the NXP Cup management team. As such, the NXP Cup in-person events such as qualifications and finals can be reduced, delayed or cancelled to abide by the security restrictions imposed by local authorities, schools, universities and the NXP Semiconductor Security team.

The NXP Cup Rules 2020/2021 EMEA Rules

Throughout the span of the 2020/2021 NXP Cup EMEA season, the NXP Cup management team will be briefed and stay informed about the development of the pandemic and will take any necessary actions to ensure the safety and good health of its participants.

The NXP Cup management team has established a 2-levels safety grading to help evaluate the risks and help with alternate participation conduits to enable the maximum number of students to demonstrate their skills and the work they have done. However, the NXP Cup management team cannot guarantee that all students will have the opportunity to compete into the challenge depending on the level of safety at the moment of a possible event.

Please keep in mind that the 2-levels safety grading listed below will impact all regions and participants at the same time. 3 regions will have their respective 2-levels safety grading to help manage any safety situation based on the follow geographic regions:

- Region 1: Continental Europe and the UK
- Region 2: Middle East countries
- Region 3: Northern Africa countries

Level Yellow

On-campus events will be organized to reduce travel and possible cross-contamination of the COVID-19 virus. The Finals event will be virtual (Live broadcast).

On-campus events will be hosted by select universities/schools where there is a significant count of registered teams (over 5 teams).

Universities and schools have until end of January 2021 to contact the NXP Cup EMEA management team and list themselves as candidate for organizing an event.

Those events will be organized in collaboration with the NXP Cup EMEA Challenge management team in order to ensure parity between the different events. Students will be encouraged to participate within the local restrictions of count and sanitary precautions. Each event will be video recorded, and the resulting recordings will be sent to NXP for evaluation of performance.

NXP will gather all videos resulting from all events and review the performance of each team based on the information submitted via video and the content created on Electromaker.io’s platform. NXP reserves the right to ask for a copy of the code created by the students for evaluation. The code submitted to NXP might be loaded on a test vehicle

at the NXP facility for testing. Code will not be shared to other teams or professors without prior consent of the team members.

This might result in some participants not being able to attend NXP Cup events. The NXP Cup EMEA Challenge management team will use the content uploaded into the Electromaker.io platform to review each team's work and provide appreciation prizes to the students.

In the case of a Level Yellow condition, the ranking of the teams will be based only on the following criteria:

- Quality of the documentation uploaded into the Electromaker.io project platform
- Video content received during the event at the selected university/school
- Evaluation of the code when received at NXP (via email)

The scoring of the teams will be performed based on:

- Performance during the university event and documented via video
- Evaluation of the code created by the team

NXP will award teams based on the performance of the Obstacle Avoidance and timed race challenges.

In addition, NXP will evaluate all teams for a chance to win the "Creativity and Design Award" based on the project documentation loaded into the Electromaker.io platform.

Level Red

Lockdowns, travel restrictions and/or assembly restrictions at regional or country level are active and do not allow any participants to publicly show their work and run their cars during an NXP Cup event.

Under this restriction level, NXP will evaluate all teams for a chance to win the "Creativity and Design Award" based on the project documentation loaded into the Electromaker.io platform. All teams will also receive a thank you gift from NXP via their coordinators.

4. Conditions of Enrollment

Teams must register online to participate. The registration opens in October and closes on 15 January 2021. Link to registration can be found → here

- Team member count must be 1 (one), 2 (two) or 3 (three)
- Each team member must be a student from a registered school. Enrolled team member 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.
  EXCEPTION: if you have been a team member of the 2019/2020 season, you are allowed to sign up again with your team for the 2020/2021 season regardless of the status of your studies.
- 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, association or club.
- 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. For those participants that are from the 2019/2020 season, NXP will do automatically the validation of your enrollment based on the information entered in the 2019 registration list.
- 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.
- Enrolled teams agree to create a project logbook on Electromaker.io. and share their progress on the Electromaker projet platform. The registration into Electromaker.io is mandatory in addition to the enrollment into the NXP Cup enrollment system
- 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.

5. 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 (DFRobot model 2019 or model 2020, Model-C or Alamak)
- Acquire a commercial kit (recommended scale 1/16)
- Build their own kit (example: 3D-Print, wood laser cutting, Lego…)

Item	Alamak Kit	Model C kit	DFRobot Brush	DFRobot Brushless
Photo				
Body Structure	Unibody	Segmented Body	Unibody	Unibody
Size	28,5 x 16 x 7 cm	28,5 x 16 x 8 cm	32.5c m length	32.5 cm length
Motors	7.2v 380 brush (2 units)	7.2v 260 brush (2 units)	Brush (2 units) ESC 160A	Brushless (2 units) 1000 Rpm/V
Stearing gear	15 kg cm	6.5 kg cm		
Tire diameter	65mm	50mm	64mm	64mm
Wheel base	16 cm	16 cm	17.3 cm	17.3cm

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 kit (for Model-C and Alamak)
- 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) into the Log Book. The restrictions for modifications or creation of new electronics are:

- The default camera (for Model-C or Alamak) 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 the Mouser NXP Cup microsite and 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 requirements
    - 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 5300mAh
    - LiPo (Lithium Polymer) batteries can be used but are limited to 2s models (2 series of cells) 7.4 maximum rating of 5500mAh
    - 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 scale is 1/16.

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.

6. Team Log book

Each team must enroll into Electromaker.io and create a logbook about the specifications of their car. All car kits are to be documented unless they are of the original Model-C or Alamak kits:

- Car make, overall size, motor and battery information
- Board and electronics information (board model with full reference part number)
- Schematics of boards used unless they are NXP's original boards
- Bill of Material
- Specific performance parameters for the choice of the car kit and electronics

The log book must be delivered before the technical inspection time at the event (both a the qualification and final event if applicable) as a PDF File sent via email at email address (matthias.wilkens@nxp.com). A printed copy is acceptable in addition to the email. Students might be called during the technical inspection to show their Logbook and answer questions from the NXP Cup organizing team.

7. Vehicle Technical Inspection

Obstacle Avoidance Challenge

Before the challenges the judges will validate that the cars are in compliance with the rules. This includes vehicle specifications and equipment requirements listed in this document.

Note: different sets of electronics and sensors can be installed on the car for each Extra Discipline. For example, a LIDAR sensor can be installed for the obstacle avoidance and removed for the speed race. However, team members must comply with the time constraints during the event to avoid creating delays on the racing and challenge schedule.

Log book must be readily available (see Paragraph Team Log Book) before the technical inspection.

Timed Race

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.

Logbooks must be provided (see Paragraph Team LogBook) before the technical inspections.

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.

8. Procedure for on-campus events

Reminder: Scheduling of the NXP Cup events is based on the COVID-19 Pandemic situation and the 2-levels safety grading in place at that moment. Restrictions based on the level of safety will also impact the criteria and awards for the NXP Cup EMEA 2020/2021 season (see paragraph “Situation with the COVID-19 pandemic”)

As such, only the obstacle avoidance and timed race challenges will be performed.

In the case of a “Level Yellow”, the selected schools/universities organizing the event will receive specific separate instructions concerning the organizing of the event. The following procedure is recommended for the on-campus events (more details to be provided to all organizing schools/universities):

1) Event is scheduled in agreement with the NXP Cup EMEA organizing team

2) The appropriate hygiene and social distancing measures agreed with the local authorities and NXP must be respected. The targeted event room must provide sufficient ventilation and opportunity to open windows to comply with COVID-19 safety regulations.

3) Event should be organized over a 1-day period to help with the organizational logistics of the event

4) Teams are allowed to test their cars on test tracks in the room in which the main event will be organized. It might be the case that only a limited of teams or team members can attend the training session at the same time to comply with social distancing regulations on the following tracks:

    a. Test track for obstacle avoidance

b. Speed test track(s) with timing system installed

5) During the morning, a time is set for teams to do the obstacle avoidance challenge. Each session of the obstacle avoidance is video recorded and documented per the special instructions sent separately.

6) 90 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

7) All students and team members are asked to leave the event room premises

8) 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.

9) Once the tracks are built, teams are allowed to enter the room (based on social distancing limitations) but cannot access their cars to test.

10) The procedure for the timed race is followed and each step is documented via video

11) Final scoring is done based on the scoring system documented into these rules. The final scoring spreadsheet, the video content for the top 5 teams alongside a team picture and the code running on the car during the timed race are to be submitted via .zip file to NXP for validation. The material will be used by the NXP Cup organizing team to evaluate the performance of each team and select the NXP Cup EMEA Champion.

9. Scoring system

A scoring spreadsheet will be provided to each on-campus organizing team to document the performance of the participating teams.

The final scoring will be done when all videos and results from each on-campus even are received by NXP. The champion team is the one that accumulates the highest number of points.

Each team succeeding in the obstacle avoidance will score 250 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

During the on-campus event, teams can collect points from the “Obstacle avoidance” discipline. The points add up with the final time ranking of the timed race.

If teams score the same total points, the ranking is performed based on the ranking of the “Timed Race” lap time.

Example: if teams A, D and F all have a total scoring of 800 points and the lap times for the final race are:

Team A: 34,5 seconds, Team D: 32,4 seconds and Team F: 40,2 seconds then the ranking is:

- Higher rank: Team D
- Second rank: Team A
- Third rank: Team F

This ranking system applies to any level in the final ranking of teams.

Only one team will be crowned the NXP Cup 2020 EMEA Champion.

Timed Race Procedure

The timed race is mandatory. The Race start order will be determined by a random drawing or based on sanitary restrictions due to COVID-19. The random order is to be communicated before the race to the participating teams for the on-campus event.

Each race is to be video recorded to document the validity of the event. In the case that a recording is of bad quality or does not show the whole race procedure, the team’s results will not be included into the final evaluation of the results of the NXP Cup EMEA.

The track layout will be the same for all on-campus races and communicated only 60 minutes prior of the event to the event organizers at the campus. No training on the disclosed track layout is allowed and no communication of that layout is to be shared to the general public or another teams.

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

Video recording starts when the team is called to the racetrack.

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.

Obstacle Avoidance Challenge

Teams will participate on a small size track (track example: oval with 2 straight track segments in a row and a 180-degree curve).

The car is positioned to start on a straight segment.

First round will be an ordinary round on a regular track.

After completing the first round, the jury will place the obstacle on one of the straight track segment (in any position on the straight segment).

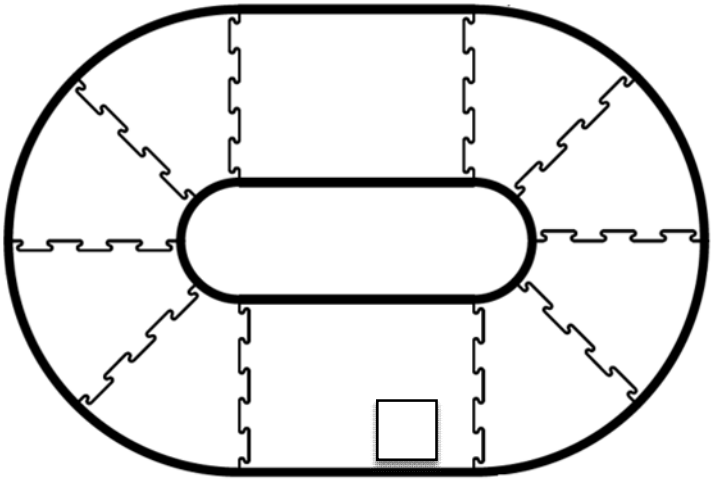
The race car must avoid this obstacle. Neither the tires nor the chassis are allowed to touch the obstacle.

Pace (speed) does not count into the scoring.

No wheel or part of the wheel is allowed to get out of the track.

The maximum time allowed to close the track is 90 seconds. The obstacle will a white cube (made out of Styrofoam or similar) with dimensions of 20x20x20cm. Only 1 attempt is allowed.

The position of the cube might not be as described as on the image below.



10. 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.

11. 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 Timed Race

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].
- The race car fails to stop within 2 meters/6 feet of the finish line or leaves the track after crossing the finish line [+1 second]
- The racecar exits the racetrack after crossing the finish line [+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 racecar 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.

During the Obstacle Avoidance Challenge

Referees will determine whether the racing car ran out of the race track.

Any of the following conditions qualifies as a foul and will count as a void attempt:

- The racecar fails to start within 30 seconds after beginning of the attempt.
- The racecar exits the racetrack
- Any part of any wheel leaves the race surface
- The racing team fails to get prepared for the attempt within the one (1) minute after being cleared to start the challenge

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
- Failure to allow the sharing of the Team Log Book on Electromaker.io
- 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.

12. Timing/Scoring

During the timed race

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.

During the Obstacle Avoidance Challenge

The time is captured using a hand-held timer.

13. 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°.

Follow this link to learn more about the configuration.

14. Contact Information

The organizing team is composed of the following persons:

Matthias Wilkens: matthias.wilkens@nxp.com

Flavio Stiffan: flavio@stiffan.eu

15. 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.