The NXP Cup Official Rules

Season 2018/19

Update version November 2018

The NXP Cup Rules 2018-2019 EMEA Rules

Change log

The change log gives you an executive summary of what have changed compared to the NXP CUP 2017/18. Read carefully all the rules through.

- Teams consist of 2-3 members. Participants can be of any field of study. Students of all grades can team up as they wish (middle-school with middle-school, high school with high school, bachelor with bachelor, master with master or mix) as long as the number of students per team is within the rules

- Team participants can also come from robotic clubs or STEM associations

- There is no more limitation on the count of sensors. You can add up as many sensors as you want on the car. NXP sensors must be used when such sensors are available into the NXP product line card.

- 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.

- The track dimensions change slightly from 60cm to 55cm width. Also, the track material is new. The new track is less prone to error, provides easier storage and assembly mechanisms.

- There are new Optional Extra Disciplines in the NXP Cup besides the classic “Timed race”: there will be “Figure 8”, “Obstacle avoidance” and “Speed limit zone” to earn extra points.

- No more technical report is needed. However, each team is to provide a log book of the changes made to the originally purchased kit. Any modification or addition to the starter kit from The NXP Cup must be documented

- Model-C and Model Alamak are allowed to the games. Both Model-C and model Alamak will compete into the same race.

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Introduction

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

The NXP Cup EMEA 2018/19 season is a transition year between the Model-C car (used for the last 7 seasons in EMEA) and the new and more performant Alamak Model. Teams have the choice to enter the challenge on either model but cannot switch model during the development of their race car. All teams using Model-C must be aware there are no more spare parts available on the market.

Both Model-C and model Alamak will compete into the same race. Unlike season 2017/18, there will not be two separate races for Model-C and Model Alamak.

The NXP FRDM-KL25 board is the preferred and supported board for the NXP Cup. However, participants can decide to use other boards as long as they are powered by a NXP MCU or MPU.

Also, regardless of the board used (MCU like FRDM-KL25 or FRDM-KL66, MCU like i.MX boards) all teams will compete in the same group – there will only be one 2018/19 NXP Cup Champion team.

1. Conditions of Enrollment

1. Teams must register online to participate. The registration opens in October 2018 and closes on 30 November 2018. Link to registration can be found → **here**
2. Team member count must be 2 (two) or 3 (three) participants and 1 (one) team coordinator (e.g. a professor). The coordinator can be a team member if no university professor is associated with the team.
3. Participants who have reached the minimum age of 14 years and have a residence in the country in which they are registered for school or university are eligible to participate. Coordinators have a minimum age of 18 years.
4. 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.

5. Participants under the age of 18 years must provide written consent from their parent(s) or legal guardian(s) before registering for the challenge. The parent(s) or legal guardian(s) of participants under the age 18 years agree to this Rules on behalf of the participant.
6. All registered teams will compete in the same race regardless of the education grades of the students composing the team
7. Team members might be from different schools, universities, associations or clubs.
8. 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.
9. 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.
10. It is forbidden for non-student support team to build and program the racing car. Employees of NXP and affiliated companies involved in the conception and implementation of the NXP Cup and their relatives are unfortunately excluded from participating in the NXP Cup. However they can participate outside the formal competition.
11. Enrolled teams agree to share their log book (as described in these rules) on communities.
12. Participants, coordinators, advisers, and audience are expected to exhibit good sportsmanship. Any inappropriate behavior or cheating may result in disqualification. Teams must decide upfront if they will be racing on the Model-C or the Alamak model at time of registration. Teams cannot switch model during the development of their car after the registration has been approved.
13. 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 to qualify.

2. Equipment Requirements

Each team shall use the NXP Cup Car kit of parts and components 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.

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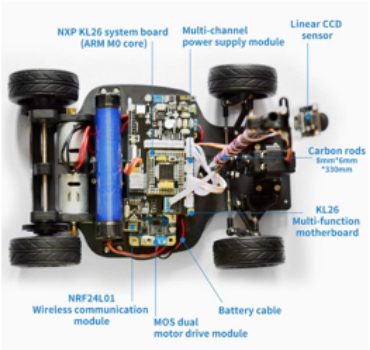
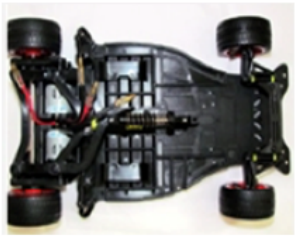
Car rules:

The original and unaltered equipment must be used as the entry. There are two (2) authorized NXP car model kits for the 2018/19 season.

There are two (2) authorized NXP Cup car model kits for this season.

	Alamak kit	**Model-C kit**
Picture		
Body structure	One-piece body	Segmented body
Size	28,5 x 16 x 7cm	28,5 x 16 x 8cm
Motors	7,2v 380 motor x2	7,2v 260 x2
Stearing gear	15kg. cm	6,5kg. cm
Tire diameter	65mm	50mm
Wheel base	16cm	16cm

The NXP Cup EMEA Model Type-C model:

All teams using Model-C must be aware there are no more spare parts available on the market.

Model C kit includes:

- NXP's FRDM-K25Z MCU Board
- Outer tire treads and rim
- 2 Drive-DC motors
- Transmission Ratio of Drive Motor (TFC-Shield)

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- Servo Motor Futaba S3010
- Allowed mechanical modifications and restrictions:
    - You may not change the wheel base (distance between wheels)
    - No part of the car shall exceed dimensions of 250mm (W) x 400mm (L) x 305mm (H)
    - You may drill holes and mount auxiliary pieces on the chassis assuming it is contained within the above dimensions.
    - You may change the orientation of the servo motor and related linkages.
    - You may add a "skin" to the car but it must be removable during inspection.
    - You may adjust or remove springs, linkages, and other non-essential pieces.
    - You may adhere the tread to the rim of the wheel.

The standard Alamak car race model includes the following components:

- NXP’s FRDM-K25Z MCU Board
- Outer tire treads and rim
- 2 Drive-DC motors
- Landzo Motor Control board
- Landzo Power Board
- Servo Motor Landzo
- Allowed mechanical modifications and restrictions:
    - You may not change the wheel base (distance between wheels)
    - No part of the car shall exceed dimensions of 250mm (W) x 400mm (L) x 305mm (H)
    - You may drill holes and mount auxiliary pieces on the chassis assuming it is contained within the above dimensions.
    - You may change the orientation of the servo motor and related linkages.
    - You may add a "skin" to the car but it must be removable during inspection.
    - You may adjust or remove springs, linkages, and other non-essential pieces.
    - You may adhere the tread to the rim of the wheel.

Along with the race car model, the NXP MCU board FRDM-KL25Z is being included in each new Alamak kit. However, participants are allowed to use other 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.
Any board modification 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 as long as it is either with an NXP MCU / MPU or no embedded MCU / MPU.
- The MCU or MPU 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 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.
- Total added capacity of all capacitors should not exceed 2000 uF

You can add up as many sensors as you 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
- A 3-axis sensor
- An Optical sensor
- An Ultrasonic sensor
- A Gyroscope sensor
- And others

Every default car kit delivery contains a 7.2V 2500mAh Ni-MH battery. However, participants are allowed to use their own battery as long as it stays within the following limits:

- Maximum 7.4V, <=3000mAh, rechargeable NiCd, NiMH or Li-ION (LiPo batteries are not allowed)
- Only one (1) battery at a time may be used to power the vehicle and any attached hardware

3. Log book

Each team is to provide a log book of the changes made to the originally purchased kit. Any modification or addition to the starter kit from The NXP Cup must be documented with:

- Schematics
- Bill of Material
- Reason for the change from the starter kit
- Specific performance parameters for the change/addition

The log book has to be presented before the technical inspection time at the event as a PDF File sent via email at email address (matthias.wilkens@nxp.com).

4. Vehicle Inspection

Optional Extra Disciplines

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

Log book must be readily available (see Paragraph 3: 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.

Log books must be provided (see Paragraph 3: Log Book) 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.

5. Race procedure

There is one main race (timed race) and 3 additional Optional Extra Disciplines to earn extra points. During the finals, participating teams collect points. While the smaller Optional Extra Disciplines give less total points, the timed race is the main attraction and toughest discipline with the most points to earn. The additional

Scoring system:

Best Lap time	**TIMED RACE (MAIN)**	90 secs - most completed laps	**FIGURE 8**	Successful completion	**OBSTACLE**	Successful completion	**SPEED LIMIT**
1st	500	1st	200	success	150	success	150
2nd	400	2nd	150				
3rd	350	3rd	125				
4th	300	4th	100				
5th	250	5th	75				
6th	200	6th	50				
7th	150	7th	40				
8th	100	8th	30				
9th	50	9th	20				
10th	25	10th	10	no success	0	no success	0
Remarks	mandatory race	optional race		optional race		oprtional race	

During the Qualification and Final events, teams can collect points within different disciplines. The main discipline, the “Timed race” will bring the most points and is mandatory. “Figure 8”, “Obstacle avoidance” and “Speed limit zone” are optional races and

give the possible to earn additional points. Here, students have the chance to get a higher rank in the overall ranking.

Example: Team A has the fastest lap time in the “Timed race”, becomes 7th on “Figure 8” and decides not to participate in the remaining two disciplines. In total Team A will have **540 points**.

Team B becomes 3rd in the “Timed race”, 1st in “Figure 8” and successfully completed “Obstacle avoidance” and “Speed limit zone”. In total Team B will have **850 points**. Team B will be the overall winner.

If the total points of two teams will be at par, there will be a final race between the two teams at the “Timed race” track. The faster time wins.

At the qualification events, a select number of teams will advance and qualify for the finals. The count of teams allowed to be selected will be communicated at the beginning of the qualification event. The ranking of the teams follows the scoring rules described above.

At the Finals event, the ranking of the teams follows the scoring rules described above. Only one team can become the NXP Cup 2018/19 EMEA Champion.

Timed Race Procedure

The timed race is mandatory. The Race start order will be determined by a random drawing.

There will only be one race for both models (Model-C and Alamak models). The teams will race on the same race track layout regardless of car model and team members’ composition education grades.

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:

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

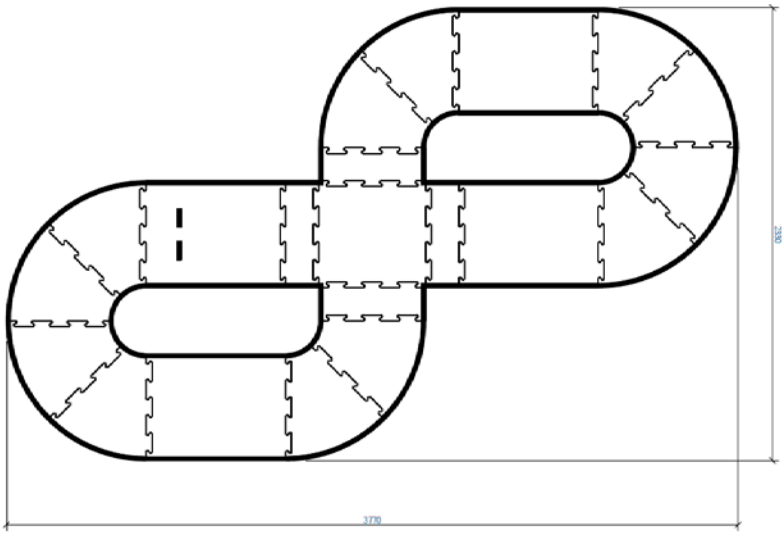
Optional Extra Disciplines

The 3 additional challenges will be rewarded with additional points (see scoring system). All challenges take place on the same track elements as the NXP Cup “Timed race”, meaning, same line thickness and same width of track. These disciplines are not mandatory, however there are better chances to win the overall NXP Cup participating in all challenges (see scoring system).

Figure 8

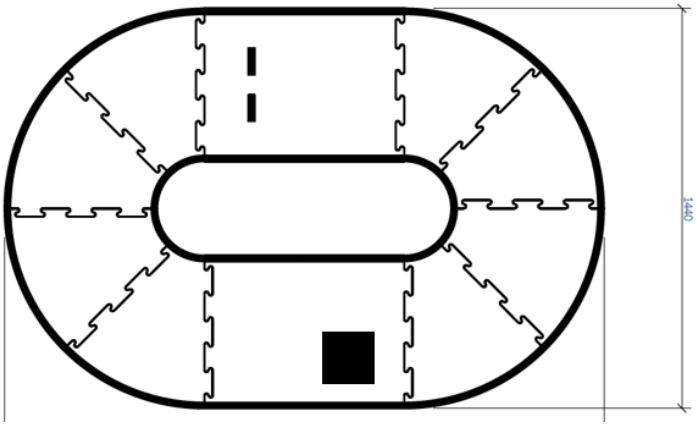
The Figure 8 track will be in a similar shape as an “8”. It will contain curves, straights and an intersection. Participants will have 90 seconds to complete as many laps as possible. Only fully completed rounds will be counted. The Figure 8 is a precision and reliability task. No wheel or part of the wheel is allowed to get out of the track.
Participants have 3 attempts to complete the maximum number of laps in 90 seconds. If a participant fails (car exits the track or part of a wheel exits the track) during the 90 seconds, he can retry up to 3 times. If the attempt is successful (90 seconds without exiting the track or part of a wheel out of the track), the count of laps is the one recorded for the challenge and other attempts are voided.

The team with the most completed laps will earn the most points. Participants have 1 minute of time to tune the car between each attempt.



Obstacle avoidance

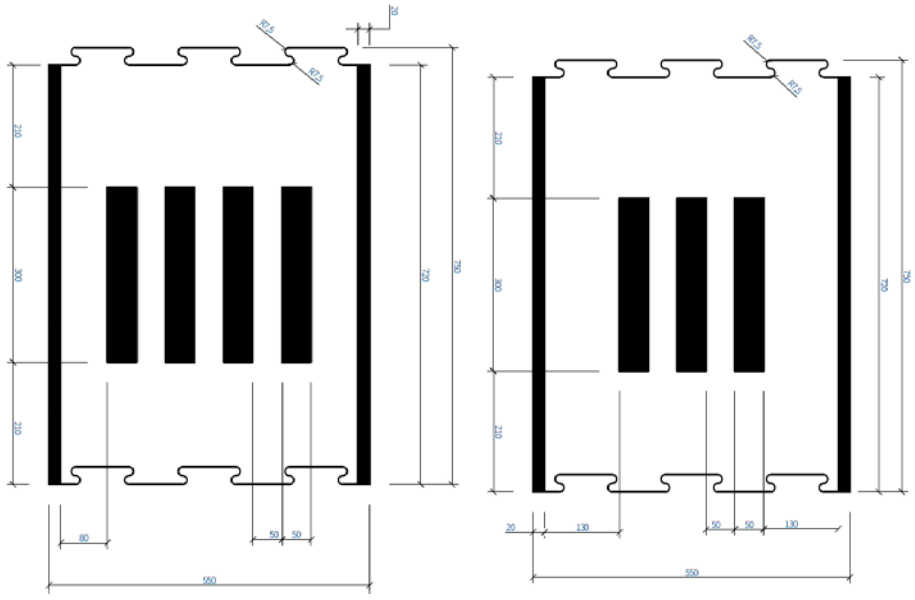
Teams will participate on a small size track (example: oval with 2 straight track segments in a row and a 180-degree curve). First round will be an ordinary round on a regular track. After completing the first round, the jury will place the obstacle on one of the straight track segment. The race car has to avoid this obstacle. Neither the tires nor the chassis are allowed to touch the obstacle. After the car has reached the finish line, the task has been completed successfully. Pace 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 with dimensions of 20x20x20cm. Only 1 attempt is allowed.



Speed limit zone

Teams will participate on a small size track (example: an oval with 2 straight track segments in a row and a 180-degree curve). When the car sees the 4 stripes pattern

designating the beginning of the speed zone, the car must reduce its speed significantly (about ½ of the initial speed). When the car sees the 3 stripes pattern designating the end of the speed zone, it must resume its original speed. Once those steps are done, the task has been completed successfully.
No wheel or part of the wheel is allowed to get out of the track.
Pace does not count into the scoring. The maximum time spend on the track is 90 seconds. Only 1 attempt is allowed.



6. Race Day Schedule

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

The typical schedule is:

- Practice Time: prior to the 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”.
- Optional Extra Discipline tracks will be available at designated times during the practice time for teams to score their optional challenge points.
- Teams will not be called to the Optional Extra Disciplines. It is their choice to attend and record extra points.
- The timed race is the last event of the day. At the designated time, all cars must be set for final inspection on the inspection tables. Training time is ended.
- Reconfigure practice track to final track (layout not disclosed to the participants)
- Vehicle Inspection (see section 4)

- Timed Race
- Communication of the results and qualified teams
- For the EMEA Finals only: Awards Ceremony
- Conclusion of the event

7. Event Personnel

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

The NXP organizing team will name some referees. They are 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.

The NXP organizing team will also name some judges to Interpret and enforce rule compliance. This will be comprised of NXP employees and members of contributing industry sponsors.

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.

8. Fouls, Failure and Disqualifications during the timed race

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 race track 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 Optional Extra Disciplines

During the optional Extra Disciplines, 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
- The racing team exeeds one (1) minute time between two (2) attempts (where applicable)

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 Log Book
- 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.

9. 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 Optional Extra Disciplines

The time is captured using a hand-held timer.

10. The Race Track

Test tracks are laid from track elements that will be used during the final race as test track for calibrations and tests. The actual layout of the tracks for the Optional Extra Disciplines and Timed Race are unknown to the competitors the time of each challenge. The race track specifications are as follow:

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

- The race track can have inclines, declines and tunnels
- The additional challenges will have separates patterns. Follow this link to learn more about the configuration.

11. Contact Information

The organizing team is composed of the following persons:

Matthias Wilkens: matthias.wilkens@nxp.com

Danila Kreitz: danila.kreitz@nxp.com

Flavio Stiffan: flavio@stiffan.eu

12. Data Protection

NXP takes the protection of participants personal data very seriously and treats personal data confidentially and in accordance with the statutory data protection regulations and NXP's Privacy Policy.

Personal data is collected and processed in accordance with the NXP CUP EMEA Challenge 2019 privacy amendment. Detailed information about the amendment can be found at https://community.nxp.com/servlet/JiveServlet/download/335083-7-434582/NXP+Cup_privacy_addendum.pdf

13. Miscellaneous

The rules are subject to change by NXP if necessary. NXP reserves the right to cancel, suspend and/or amend and/or modify the NXP Cupe at its sole discretion at any time without prior written notice . NXP makes use of this possibility in particular if due to technical reasons or legal reasons a proper execution of the Challenge cannot be guaranteed..

These official rules are drawn up in the English language. If these official rules are provided in any other language and there happens to be an inconsistency between the English version and any other versionthe English versionshall prevail.

The NXP Privacy Policy, the NXP CUP EMEA Challenge 2019 Privacy Amendment and the NXP Terms and Conditions of Participation form and integral part of these official rules.