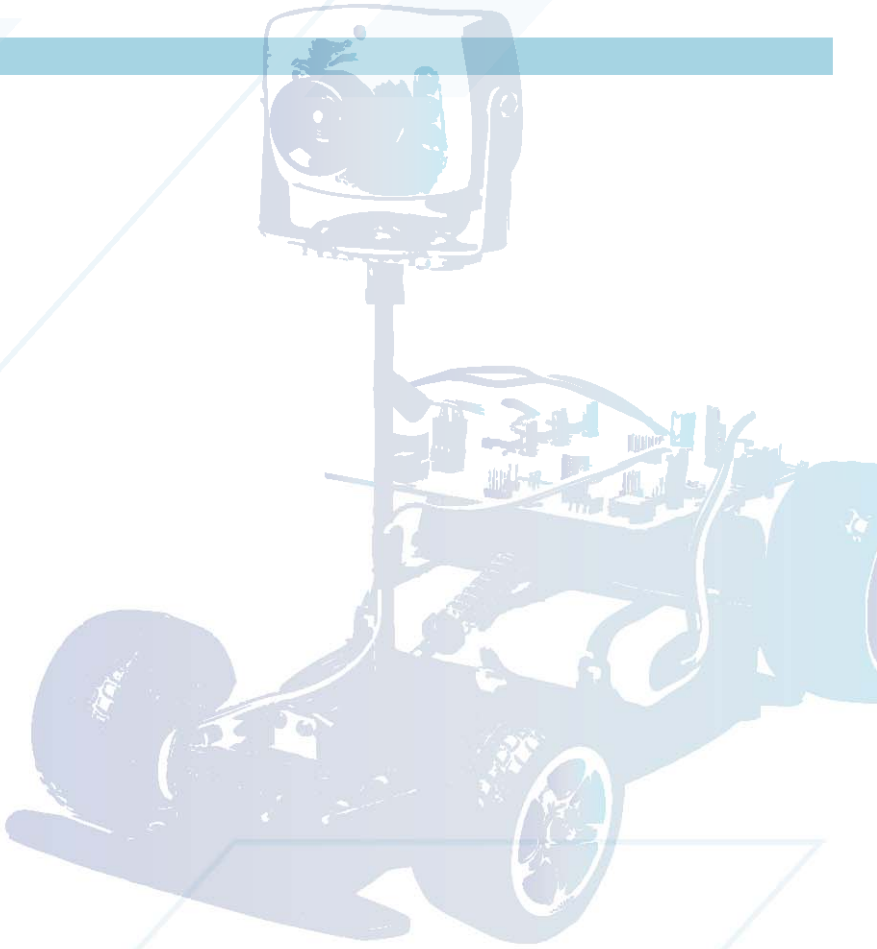

The Freescale Cup Rules
2013 USA West

Version 01a, Updated Jan 28, 2013

Revision History	
Version 1 (Oct. 30, 2012)	Original
Version 1a (Jan 28, 2013)	Added use of NiMH battery

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Overview

All racing teams should use the car model kit designated by Freescale Semiconductor. The teams are challenged to design a control scheme and autonomous race car themselves. The software includes sensor imaging collection and processing, drive motor control, and steering motor control algorithm development. The teams are required to design motor control hardware as well as the sensor interface hardware.

The judging of the event will rank using the race rules in this document. Equality and fairness will be ensured as much as possible.

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Section 1: Team Rules and Requirements

1. Only undergraduate students may participate.
2. The maximum number of people on a team is 4.
3. Cars will be designed and constructed by students only.
4. Participants are expected to exhibit good sportsmanship. Any inappropriate behavior or cheating may result in disqualification.

Section 2: Equipment Requirements

Each team will be provided the same basic kit of parts. The following rules are in place to keep the playing field level. The spirit of the game is demonstration of excellent hardware integration and superior programming.

Mechanical

1. The following original and unaltered equipment must be used in the design.
    a. Tires
    b. Drive - DC motor
    c. Transmission Ratio of Drive Motor
    d. Servo Motor
        i. Excludes connection component on output axis of the rudder
    e. Battery (purchase separately)
        i. 7.2V, <=3000mAh, rechargeable NiCd or NiMH
        ii. Only one (1) battery at a time may be used to power the vehicle and any attached hardware
    f. If any standard component of the car model is damaged, then a replacement part of the same model should be used.
2. The chassis can be modified, with some restrictions:
        i. The footprint of the frame may not be altered
        ii. You may not change the distance between wheels
        iii. No part of the car shall exceed dimensions of 250mm/9.85in (W) x 400mm/15.75in (L)
        iv. You may drill holes and mount auxiliary pieces on the chassis assuming it is contained within the above dimensions.

Electrical

1. A Freescale MCU must be used.
2. You may create custom boards.
3. You are not required to use the provided Freescale development board and/or camera.
4. One processor rule - No auxiliary processor or other programmable device is allowed.
5. DC-DC boost circuit may not exceed battery voltage.
6. Total capacity of all capacitors should not exceed 2000 uF; the highest charging voltage of capacitors should not exceed 25 V.

7. Optional Add-Ons:
    a. Maximum of three (3) servos
    b. Maximum of sixteen (16) sensors
        i. Transmitter/Receiver pair is 1 sensor
        ii. A CCD sensor is 1 sensor
        iii. The provided Line Scan Camera is 1 sensor
8. NO REPRODUCTION IS ALLOWED IN DESIGN OF THE CAR MODEL. HARDWARE AND SOFTWARE OF CAR MODELS OF COMPETING TEAMS WITHIN SAME UNIVERSITY SHOULD BE ORIGINAL AND CLEARLY DIFFERENT.

Section 3: Referee and Technical Judgment

The Freescale Cup will be carried out by the undertaking universities under direction of the organizing committee of the event.

1. Before each race, judges will perform a technical inspection of all entries. This includes vehicle specifications, dimensions, and equipment requirements listed in section 2. After judging you may not alter any parts of the vehicle. In the event of any violations, the organizing committee is entitled to disqualify the corresponding team.
2. The referees are responsible for on-track activities. This includes race track management such as starting and stopping vehicles, as well as timing and scorekeeping.
3. Any racing disputes will be taken up and resolved by the racing executive committee.
4. Workers of the organizing committee or the event team shall not aid any one specific team. Training from organizing committee shall be open to all teams and shall not disclose any information that might compromise fairness of the competition.

Section 4: Race Day Competition Procedure

1. Testing - On the day of the race, prior to any timed/scored event, a test track will be available. Final calibration may be made at this time.
2. Before any timed/scored event begins, all cars will be collected, inspected and held, until the end of the round. During this time teams are not permitted to touch the car.
3. The timed racing event is divided into two rounds: preliminary (qualifying) and the final competition.
4. A referee will direct all the racing teams when to enter the playing field in accordance with the racing order.
5. There shall be only one team member on the track at any given time. (excludes testing times)

6. Upon entering the track, a team has two minutes to set up the car and signal "Ready" to referee.
7. After the referee confirms "Ready", the vehicle should leave the starting area within 30 seconds.
8. After the race car finishes, a member of the team shall take the vehicle away from the track.
9. Event displays will post the best time for a single lap.

Section 5: Preliminary (Qualifying) Race

1. Race order will be determined by random drawing.
2. Each team is given two attempts to complete the track and post a time.
3. Teams that cannot complete the track after two attempts do not advance to the finals.
4. If there are multiple tracks, teams cannot use the same track for the second attempt.
5. The best time of the two attempts will be recorded.
6. Based on the number of participating teams, the organizing committee of the event may cap how many teams advance to the finals based on the best times in preliminary.
7. Disqualified cars will be replaced by the next car in ranking.
8. After the preliminary round has ended, the car hardware or software can be improved in compliance with competition rules.

Section 6: Final Race

1. The teams will be ordered based on preliminary results.
2. Shortest times (fastest car) during the preliminary will go last in the final.
3. The race track may be changed.
4. Each finalist has two attempts to complete the track.
5. The best time of the two attempts will be recorded.
6. The score in the preliminary will not be included in the score of the final.

Section 7: Fouls, Failure and Disqualifications

The rules will be interpreted by Freescale and the organizing committee of the event.

Foul, is a minor infraction, which results in time penalties.
Failure, results in the current attempt time not being recorded. Subsequent attempts are allowed.
Disqualification is a major infraction which results all times not being recorded.

1. During a team's racing, the on-site referee will judge whether the racing car ran out of the race track according to applicable rules.

2. Any of the following conditions will be considered a *foul* and will result in time penalty added:
    a. The race car fails to leave the starting area within 30 seconds after beginning of the race [+1 second].
    b. The race car fails to stop 3 feet after crossing the finish line [+1 second].
3. Any of the following conditions will be considered a *failure* and no time will be given:
    a. Three or more wheels leave the race surface.
    b. The racing team fails to enter the playing field and get prepared for the racing in two (2) minutes after being called by the referee.
    c. The player touches the racing car after the technical inspection without consent of the referee.
    d. The racing car fails to finish within 120 seconds after leaving the starting area.
4. Any of the following conditions will be considered a *disqualification*:
    a. Any auxiliary lighting equipment or other auxiliary sensors is used around the race track.
    b. Modification of the hardware or software after the race has begun (except for changing the battery.)
    c. More than one team member in the playing field.
    d. Any behavior that might interfere with the movement of the car.
    e. Any cheating during the competition.
    f. Plagiarizing the car design including hardware or software. Cars from the same University but different teams must be clearly different.
    g. Failure to pass the technical inspection.

Section 8: Scoring

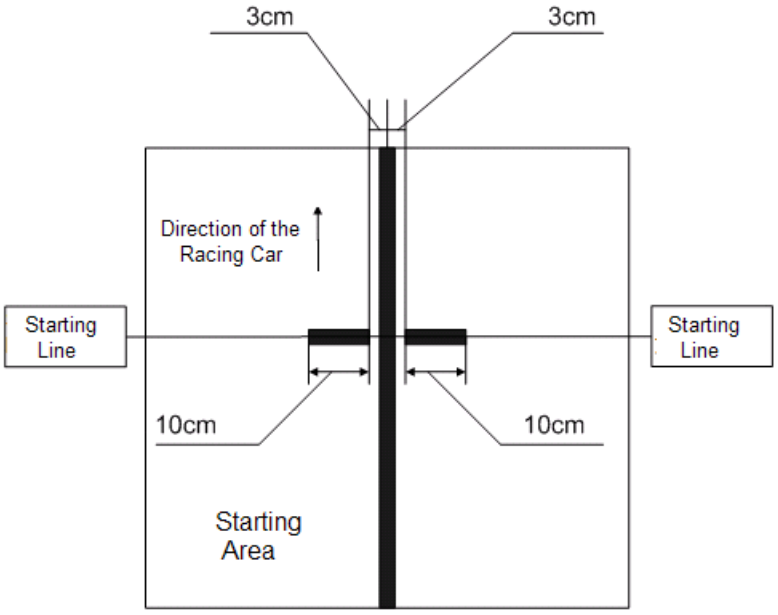
1. Equality and fairness will be ensured as much as possible on the condition of actual feasibility. Disputes will be resolved by a vote of organizing committee and judges.
2. Time starts when the racing car crosses the start/finish line.
3. Fouls will result in the time addition to the car's lap time.
4. Disqualifications and Failures will result in no score.
5. Time will be captured using an electronic gate or handheld timer.
6. [if applicable] Car design judging will be scored on the quality of construction, appearance, and design creativity.
7. [if applicable]Technical report judging will be scored on quality of content, design approach, and concept understanding.
8. The score from the preliminary round will not be included in the score of the final round.
9. The final score shall be determined by the final time of the racing car and the technical and quality content of the final report.

Section 9: Awards

Awards will be given to the top three teams who have the highest rank.

Section 10: Parameters of the Racing Track

1. Each University should create their own test track for the students to use during development. Track templates are provided on the Freescale Cup website.
2. The actual layout of the final racing track will be unknown to competitors until competition day.
3. For a limited time on race day, a test track made from the same material will be available on a first come, first serve basis for calibration and design modifications.
4. Width of the racing track shall not be less than 600mm/23.65in.
5. Material specifications regarding the surface of the racing track will be provided on the web site of the event.
6. Surface of the racing track is matte white, with a continuous black line (25mm/1in wide) drawn in the middle as the pilot line.
7. The minimum bending radius of the racing track shall not be less than 500mm/19.7in.
8. The racing track can intersect with a crossing angle of 90°.
9. Any slope in the track will be equal to or less than 15 degrees in a straight section of the racing track, including upgrade and downgrade.
10. There is a straight starting area of 1000mm/39.4in long in the racing track, as shown in figure below. In addition, there is a black starting line 100mm/3.9in long at both sides of the starting point. Start time and end time will be determined when the front part of the racing car passes the starting line. The car must be able to automatically stop within three meters of the starting line after finishing the race.



The rules and conditions are subject to change by Freescale if necessary. Freescale reserves the right in their sole discretion to cancel, suspend and/or modify The Freescale 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.