



# FSG Competition Handbook 2022

2022-01-26

## Contents

Changelog	2
Abbreviations	3
DE Formula Student Germany Competition Handbook 2022	4
DE1 General Information . . . . .	4
DE2 Registration . . . . .	5
DE3 Important Dates . . . . .	8
DE4 Competition Site Organization . . . . .	8
DE5 Static Events . . . . .	12
DE6 Dynamic Events . . . . .	12
DE7 Vehicle Requirements and Restrictions . . . . .	14



## Changelog

<b>Rule</b>	<b>Version</b>	<b>Change</b>
DE2.1.2	1.1	Add link to test quiz.
DE2.1.13	1.1	Correct payment deadline start time.



## Abbreviations

<b>ASF</b>	Autonomous System Form	<b>EDR</b>	Engineering Design Report
<b>ASR</b>	Autonomous System Responsible	<b>ESF</b>	Electrical System Form
<b>ASRQ</b>	ASR Qualification	<b>ESO</b>	Electrical System Officer
<b>BPPV</b>	Business Plan Pitch Video	<b>ESOQ</b>	Electrical System Officer Qualification
<b>CBOM</b>	Costed Bill of Material	<b>EV</b>	Electric Vehicle
<b>CEST</b>	Central European Summer Time	<b>FSG</b>	Formula Student Germany
<b>CET</b>	Central European Time	<b>FTO</b>	Fuel Type Order
<b>CRD</b>	Cost Report Documents	<b>HIC</b>	Health Insurance Certificate
<b>CTMD</b>	Cell Temperature Monitoring Device	<b>IAD</b>	Impact Attenuator Data
<b>CTS</b>	Chassis Type Selection	<b>MU</b>	Magazine Uploads
<b>CV</b>	Internal Combustion Engine Vehicle	<b>NMT</b>	Network Management Protocol (CANopen)
<b>DBOM</b>	Detailed Bill of Material	<b>PDO</b>	Process Data Object (CANopen)
<b>DC</b>	Driverless Cup	<b>RES</b>	Remote Emergency System
<b>DCPI</b>	Driverless Cup Participation Intention	<b>SDO</b>	Service Data Object (CANopen)
<b>DL</b>	Data Logger	<b>SE3D</b>	Structural Equivalency 3D Model
<b>DQ</b>	Disqualified	<b>SES</b>	Structural Equivalency Spreadsheet
<b>DSS</b>	Design Spec Sheet	<b>SESA</b>	SES Approval
<b>DV</b>	Driverless	<b>TMD</b>	Team Member Designation
<b>EAIR</b>	ESF Add Item Request	<b>VSV</b>	Vehicle Status Video
<b>EBS</b>	Emergency Brake System		



# DE Formula Student Germany Competition Handbook 2022

## DE1 General Information

### DE1.1 Competition

DE1.1.1 There will be competitions for the Internal Combustion Engine Vehicle (CV) class and the Electric Vehicle (EV) class. These will take place at the same location during the same week, together with the additional Driverless Cup (DC).

### DE1.2 Applicable Rules

DE1.2.1 The competitions will be held in compliance with the "Formula Student Rules 2022".

### DE1.3 Competition Dates and Place

DE1.3.1 FSG 2022 will be held from 15<sup>th</sup> until 21<sup>st</sup> of August 2022 in Hockenheim, Germany.

### DE1.4 Competition Website

DE1.4.1 The URL of the FSG competition website is <https://www.formulastudent.de>.

### DE1.5 Date and Time Format

DE1.5.1 The competition date/time format is "YYYY-MM-DD hh:mm" according to ISO 8601<sup>1</sup>.

DE1.5.2 The competition time zone is Central European Time (CET)<sup>2</sup> or Central European Summer Time (CEST) from last Sunday of March to last Sunday of October, Europe/Berlin.

DE1.5.3 The time of the competition website is the official time for all deadlines and decisions:  
<https://www.formulastudent.de/time>.

### DE1.6 Pandemic Situation Handling

DE1.6.1 Due to the COVID-19 pandemic the actual execution of the event is subject to change. This document will be updated once new information becomes available.

<sup>1</sup>[https://en.wikipedia.org/wiki/ISO\\_8601](https://en.wikipedia.org/wiki/ISO_8601)

<sup>2</sup>[https://en.wikipedia.org/wiki/Central\\_European\\_Time](https://en.wikipedia.org/wiki/Central_European_Time)



## DE 1.7 Vehicle Shipping

- DE 1.7.1 Teams are advised to consult their shipping company or freight forwarder to ensure that their shipment fully complies with all relevant customs, import/export and aviation shipping requirements.
- DE 1.7.2 Customs and other paperwork like ATA Carnet<sup>3</sup>, inspecting shipments as well as reporting and documenting damage of the shipment is the sole responsibility of the team.
- DE 1.7.3 Detailed vehicle shipping procedures are published on the competition website.
- DE 1.7.4 Teams should upload their shipping documents to the competition website.

## DE 2 Registration

### DE 2.1 Team Registration

- DE 2.1.1 The team registration will take place in the form of a quiz. Registration without taking part in the quiz is not possible. There will be one quiz for all competitions. The quiz will require knowledge from all fields related to Formula Student.
- DE 2.1.2 The URL of the registration website is <https://reg.formulastudent.de>. A test registration website is available at <https://t.reg.formulastudent.de>.
- DE 2.1.3 Teams must create a team account on the competition website and assign a team captain and two deputies. The deadline for this is 24 h before the registration starts, see DE 3.1. The team captain and his deputies may assign team members as participants simultaneously. Only one person (the team captain or one of his deputies) may complete the registration quiz.
- DE 2.1.4 The quiz starts as defined in DE 3.1.
- DE 2.1.5 Only one question will be visible at a time and can only be answered once.
- DE 2.1.6 Questions will have a fixed duration during which an answer has to be provided by the team.
- DE 2.1.7 When entering the quiz late, depending on the delay, the first questions will not be visible anymore.
- DE 2.1.8 Within teams with the same amount of correct quiz answers, the quiz result order will depend on the time needed for completion of the quiz. This time starts with the opening of the quiz for all teams (see DE 3.1). Teams with less correct quiz answers will be sorted behind teams with more correct answers.
- DE 2.1.9 Once the quiz has been successfully completed, the team captain or one of his deputies must register the team for the competition by agreeing to the rules and by selecting a free vehicle number. Requests for changing the vehicle number are only possible within 168 hours (7 days) after the start of the registration.

**EV      CV**  
vehicle numbers    001-199    201-399

- DE 2.1.10 The quiz will close after the time to answer the last question has expired.

<sup>3</sup>[https://en.wikipedia.org/wiki/ATA\\_Carnet](https://en.wikipedia.org/wiki/ATA_Carnet)



- DE2.1.11 No feedback if the answer was correct will be provided until the results are published on Saturday 2022-01-29 13:00 CET on the registration quiz page, see DE2.1.4. After the results are published, teams have two hours to hand in protest until 2022-01-29 15:00 CET on <https://www.formulastudent.de/fsg/feedback-quiz/>. Protests by e-mail will be ignored. Quiz times and the resulting rankings will be published on Monday 2022-01-31 13:00 CET.
- DE2.1.12 Reserved slots, see DE2.2.2, will be assigned to the teams based on past achievements. All remaining and unused reserved slots will be assigned to all other teams, with regard to their quiz result.
- DE2.1.13 All assigned teams will be placed on the pending list on the competition website. In order to move to the participating list, they have 72 h to pay the registration fee, see DE2.3. Once all slots have been filled, all additional teams will be placed on a waiting list (see DE2.4). The period to pay the registration fee starts 2022-01-31 18:00 CET.
- DE2.1.14 The technical inspection order at the competition will be based on the quiz result in the respective class.

## DE2.2 Registration Slots

- DE2.2.1 FSG 2022 is limited in total to 30 CV slots and 70 EV slots. Up to 30 of the registered teams may participate in the DC.
- DE2.2.2 Reserved slots for the CV and EV class will be assigned to the following teams:
- Three top CV and three top EV teams from FSG 2021
  - Five top DV teams from FSG 2021
  - Five top CV and five top EV teams from latest World Ranking Lists<sup>4</sup>
- The top team slots will be assigned in the above order. Duplicate teams will be filled up with the next team from the respective category.
- DE2.2.3 All remaining and unused reserved slots will become available for all other teams after the registration quiz has been closed on the registration website (see DE2.1.10).

## DE2.3 Registration Fee

- DE2.3.1 The registration fee is 1000€ and includes a 20-person team. More team members can be registered for 50€ per participant until the TMD deadline (see DE3.2). Team members may register after this deadline for a fee of 100€ per participant. There is no limit in team size and no deadline for late bookings.
- DE2.3.2 The registration fee must be paid online within 72 h by a verified PayPal account after the team has been moved to the pending list in order to move to the participating list. Otherwise the team will be de-registered.
- DE2.3.3 Registration fees are only refundable should unexpected entry restrictions prohibit the team from travelling.

---

<sup>4</sup><https://fs-world.org>



## DE 2.4 Waiting List & Withdrawals

- DE2.4.1 Teams on the waiting list may move to the participating list until 2022-08-01 13:00 CEST. This is possible if registered team withdraw from the competition. Once a slot on the participating list has become available again, the next team on the waiting list will move to the pending list and has 72 h to pay the registration fee in order to move to the participating list.
- DE2.4.2 Teams on the waiting list are required to submit all documents and forms by the same deadlines as teams on the participating list.
- DE2.4.3 Teams on the waiting and participating lists who find that they will not be able to attend the competition are requested to officially withdraw by notifying the officials.

## DE 2.5 No Driverless Events

- DE2.5.1 Teams that do not intend to run in autonomous mode at the competition must set the status "No Driverless Events" on the competition settings page. This cannot be undone. All driverless events will be scored with 0 points. The team will not be allowed to run in autonomous mode.
- DE2.5.2 Teams with the status "No Driverless Events" are not required to upload the ASF, ASRQ and the DBC file. Therefore, if these deadlines are missed, the team will not be withdrawn from the competition. All correction request for these deadlines become invalid immediately. Existing penalties remain if the status "No Driverless Events" is handed in after a deadline already expired.

## DE 2.6 Driverless Cup (DC)

- DE2.6.1 All teams must decide on the competition settings page by the DCPI deadline whether they wish to participate in the Driverless Cup (DC).
- DE2.6.2 Up to 30 DC slots will be assigned among these teams. Five slots are reserved for the five top teams from FSG 2021 DV competition, the remaining slots will be assigned in the order of the quiz results.

## DE 2.7 Team Member Designation (TMD)

- DE2.7.1 Participating team members must be assigned prior to the competition by the team captain or his deputies.
- DE2.7.2 If there are any team members who are studying at a different university, they must choose the team's university during their registration process as a team member.
- DE2.7.3 Team members may only be selected as participants by the team captain, if they have entered the following personal information in their user profiles:
- Personal address
  - Clothing size
  - Valid Health Insurance Certificate (HIC) for Germany (e.g. travel insurance)
  - FSG standard terms
- DE2.7.4 As proof of valid health insurance in Germany the following documents are accepted (English or German language only):



- For members of any EU/EWR country: the backside of their European Health Insurance Card (EHIC).
- For all other (non EU/EWR or private health insurance): a DIN A4 PDF containing the member's full name, date of birth, validity date, clear statement that insurance is valid in Germany during the time of the event.

Team members have three attempts to upload a correct HIC. Ignoring the reviewer's comments more than twice will lead to an irrevocable fail.

DE2.7.5 The submission of the signed standard terms will be handled digitally. All participants will find personalized standard terms in the **My Account** section on the FSG homepage. This document must be signed and then uploaded using the standard terms upload in the **My Account** section.

## DE2.8 Visa for Participants

DE2.8.1 All participants which passed the HIC-check, will find a personalized letter of invitation with a digital signature in their account overview.

DE2.8.2 An invitation letter with a hand signature can be ordered on the competition website. Once a fee of 90€ has been paid, the letter will be sent out within two weeks.

## DE3 Important Dates

### DE3.1 Team Registration

DE3.1.1 Team registration (see DE2.1) for all teams starts on 2022-01-28 13:00 CET with the registration quiz and ends after the registration quiz has been closed (see DE2.1.10).

### DE3.2 Deadlines

DE3.2.1 All required documents and information must be uploaded to the competition website by the team captain and/or his/her deputies by the deadlines as stated in Table 2.

DE3.2.2 All documents must comply with a maximum size of 40 MB.

## DE4 Competition Site Organization

### DE4.1 On-Site Registration

DE4.1.1 On-Site registration procedure will be defined in a later version of the handbook.

### DE4.2 Entering the Competition Site

DE4.2.1 A pink "team truck" entrance pass with a green "unload card" attached to it is handed to each team at the registration. This entrance pass must be filled out completely and displayed behind the windscreen of the "team truck" used to transport the competition vehicle and equipment to the pits.





Date	Deadline	Competition
2022-02-18 13:00 CET	Fuel Type Order (FTO)	CV
2022-02-18 13:00 CET	Chassis Type Selection (CTS)	ALL
2022-02-18 13:00 CET	Driverless Cup Participation Intention (DCPI)	ALL
2022-03-04 13:00 CET	ESF Add Item Request (EAIR)	EV
2022-03-18 13:00 CET	Impact Attenuator Data (IAD)	ALL
2022-03-18 13:00 CET	Structural Equivalency 3D Model (SE3D)	ALL
2022-03-18 13:00 CET	Structural Equivalency Spreadsheet (SES)	ALL
2022-04-01 13:00 CEST	Autonomous System Form (ASF)	ALL*
2022-04-01 13:00 CEST	Electrical System Form (ESF)	EV
2022-04-15 13:00 CEST	SES Approval (SESA)	ALL
2022-06-03 13:00 CEST	Business Plan Pitch Video (BPPV)	ALL
2022-06-03 13:00 CEST	Design Spec Sheet (DSS)	ALL
2022-06-03 13:00 CEST	Engineering Design Report (EDR)	ALL
2022-06-03 13:00 CEST	Magazine Uploads (MU)	ALL
2022-06-24 13:00 CEST	ASR Qualification (ASRQ)	ALL*
2022-06-24 13:00 CEST	Electrical System Officer Qualification (ESOQ)	EV
2022-06-24 13:00 CEST	Team Member Designation (TMD)	ALL
2022-07-08 13:00 CEST	Vehicle Status Video (VSV)	ALL
2022-07-29 13:00 CEST	Cost Report Documents (CRD)	ALL
2022-07-29 13:00 CEST	Final dbc file upload	ALL*

Table 2: Document deadlines

\* The ASF, ASRQ and final dbc file upload is not required for teams that have selected the No Driverless Events status, see DE2.5.

- DE4.2.2 The driver may queue the “team truck” only after the entrance passes are filled out.
- DE4.2.3 The total length of the “team truck” including a possible trailer must not exceed 12 m.
- DE4.2.4 The team is entitled to enter the competition site only once with their “team truck” for a maximum of 30 min for the purpose of unloading their competition vehicle and equipment.
- DE4.2.5 Afterwards the “team truck” must be moved outside of the Hockenheimring.
- DE4.2.6 It is not possible to drive to the pit area again with the “team truck” during the event before loading on Saturday.
- DE4.2.7 On Sunday 2022-08-21 the team is entitled to enter the pits once with the “team truck” for a maximum of 30 min for the purpose of loading.
- DE4.2.8 On request, teams may receive an additional yellow entrance pass that allows one passenger vehicle to enter the pit area for the next hour. These passes are only given out from Wednesday 2020-08-18 until Sunday 2022-08-21 11:00 CEST.



### DE 4.3 Announcements

- DE4.3.1 All announcements can be found on the competition website  
<https://today.formulastudent.de/>.

### DE 4.4 Competition Site

- DE4.4.1 The use of motorcycles, quads, bicycles, scooters, skateboards or other similar mobility devices as well as self-propelled devices in general by team members and spectators is prohibited.
- DE4.4.2 Lost & found items must be picked up until Sunday 2022-08-21 20:00 CEST at event control.
- DE4.4.3 Confiscated goods must be picked up until Sunday 2022-08-21 18:00 CEST at a place to be announced. Confiscated items that are not picked up in time will not be kept.

### DE 4.5 Welding

- DE4.5.1 FSG provides an approved welder. Outside of the opening hours it is possible to weld with own equipment in the welding area only, using appropriate safety gear.

### DE 4.6 Tyres

- DE4.6.1 FSG provides a tyre changing service.

### DE 4.7 Fuel Station

- DE4.7.1 Open fuel containers are not permitted at the event.
- DE4.7.2 All fuel containers must be DOT approved.
- DE4.7.3 Refueling is only allowed at the fuel station.
- DE4.7.4 Waste oil is to be taken to the fuel station for disposal.

### DE 4.8 [CV ONLY] Engine Test Area

- DE4.8.1 Engines may only be run in the designated engine test area during the opening times and only after passing the tilt test.

### DE 4.9 Team Briefing (A6.3)

- DE4.9.1 Team briefing procedure will be announced in a later version of the handbook.
- DE4.9.2 All drivers and team captains need to attend/watch the team briefing preceding each dynamics day.

### DE 4.10 Driver Registration

- DE4.10.1 Driver registration will take place during the egress tests in the pits. All drivers must have their government issued driver's license and national ID card as well as their student ID ready for inspection.



## DE 4.11 Technical Inspection Time Schedule

DE4.11.1 The technical inspection parts pre-inspection, accumulator inspection, mechanical inspection, electrical inspection and driverless inspection will be conducted within a strict time schedule where every team will get a predesignated time slot based on the registration quiz order. The time schedule will be published on the website shortly before the start of the competition.

## DE 4.12 Transponders / Timekeeping

DE4.12.1 In order to have the car be identifiable during dynamic disciplines, Timekeeping will stick three RFID tags to the car. There will be one tag on the front, center and rear of the vehicle. They will all be on the left side (as shown in figure 1).

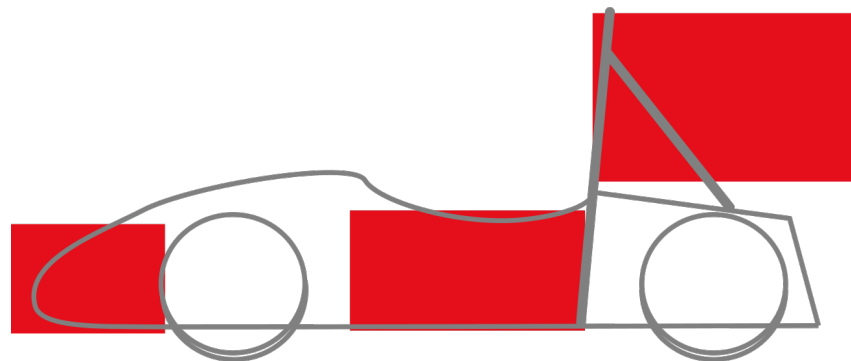


Figure 1: RFID Tag Placement Areas

- DE4.12.2 The location of the tags is decided by the officials. Areas where the driver will touch to get in or out and any sponsorship sticker will be avoided if possible.
- DE4.12.3 The area on the car will be cleaned (regular window cleaner) to apply velcro tape to mount RFID tags.
- DE4.12.4 If an RFID tag gets damaged, please contact Event Control. This will not result in a penalty.
- DE4.12.5 The RFID tags must not be fixed in any other way than done by the officials initially. This especially includes safety wiring or tape, as both interfere with the detection of the tags. In the unlikely event that a tag loosens from its mounting, this will never be treated as the team's fault.
- DE4.12.6 After the competition, these tags must be returned to the event control by Sunday, 2022-08-21 18:00 CEST.
- DE4.12.7 Live-timing is provided at <https://tk.formulastudent.de>. The shown data is unofficial.

## DE 4.13 [EV ONLY] Charging

- DE4.13.1 The charging area is a separated dynamic area including separate entrance restrictions.
- DE4.13.2 Only three members per team may enter the charging area at the same time. One of them must be a Electrical System Officer (ESO) or Autonomous System Responsible (ASR), respectively.



DE4.13.3 Inside the charging area, team members must not wear any conductive jewellery and must not wear any conductive objects of any kind which could touch the accumulator.

DE4.13.4 400V, 50Hz, 3-phase CEE charging connectors (3L+N+PE 6h) with 16A and 32A as well as 230V, 50Hz, 1-phase CEE 7/3 "Schuko" are available in the charging area.

## DE5 Static Events

### DE5.1 Detailed Bill of Material (DBOM)

DE5.1.1 For FSG 2022 a DBOM (see S2.5) for the "Chassis and Body System" must be submitted.

### DE5.2 Costed Bill of Material (CBOM)

DE5.2.1 For FSG 2022 a CBOM (see S2.6) for the "Suspension System" must be submitted.

## DE6 Dynamic Events

### DE6.1 Endurance Running Order

DE6.1.1 The running order for the endurance according to D7.3 will be published before the start of the endurance.

DE6.1.2 At least the five next vehicles according to the running order must queue up at any time during the endurance.

DE6.1.3 The queue must be continuously filled up by the following vehicles.

DE6.1.4 A vehicle is defined as running out of order and penalized according to D9.2.1 if it is missing from the queue.

### DE6.2 Driverless Events Track Marking

DE6.2.1 The markings of all dynamic events will have the following characteristics:

- The track is marked with cones.
- The left borders of the track are marked with small blue cones.
- The right borders of the track are marked with small yellow cones.
- Exit and entry lanes are marked with small orange cones.
- Big orange cones will be placed before and after start, finish and timekeeping lines.
- If not defined otherwise in chapter D of the rules, the maximum distance between two cones in driving direction is 5m. In corners, the distance between the cones is smaller for a better indication.
- The start, finish and timekeeping lines as well as keep out zones around the timekeeping equipment are marked with red, orange or pink paint.



- Additionally for skid pad and trackdrive, track limit lines on either side of the track and entry/exit lanes may be marked with yellow, green or white paint.
- There are no track limit lines for acceleration and Emergency Brake System (EBS)-test.

DE6.2.2 All lines are spray painted with the chalk-based marking paint "Soppec - Tempo T.P."<sup>5</sup>.

DE6.2.3 The cones used at the competition are equal to the cones listed in Table 3 despite that there will be letters "FSG" on the black/white band of the cones (white/black respectively).

DE6.2.4 The manufacturer WEMAS<sup>6</sup> does not sell the cones to end customers, but they may be purchased from [baustellenabsicherung24.de](http://baustellenabsicherung24.de)<sup>7</sup>.



big orange cone  
two white stripes

WEMAS  
307.610500.00.00

285 mm × 285 mm × 505 mm  
1.05 kg



small orange cone  
single white stripe

WEMAS  
400.000013.00.00



small yellow cone  
single black stripe

WEMAS  
400.000013.01.10

228 mm × 228 mm × 325 mm  
0.45 kg



small blue cone  
single white stripe

WEMAS  
400.000043.00.00

**Table 3:** Cone specs

DE6.2.5 There are the following limitations mainly resulting from the Hockenheim track conditions and organizational/authorizational issues:

- The lines may not be perfectly and continuously drawn.
- There may be further markings, to those mentioned above, that are not part of the track (e.g. markings, including cone position markings, lines from other events or different colored surface, etc.) on or close to the track which will not be removed by the officials.
- There may be (stacked) spare cones standing at the trackside at distinguishable distance.
- No special artificial landmarks are provided by officials. The team must not place additional landmarks on the track or inside the dynamic area.
- No map data is provided by the officials.

DE6.2.6 Figures 2, 3 and 4 visualize the track layout descriptions given in D4.3, D5.1, and D8.1.

<sup>5</sup><https://soppec.com/gb/construction-marking-spray-paints/13-tempo-tp.html>

<sup>6</sup><https://www.wemas.de>

<sup>7</sup><https://baustellenabsicherung24.de/leitkegel-titan-180-1934.html>

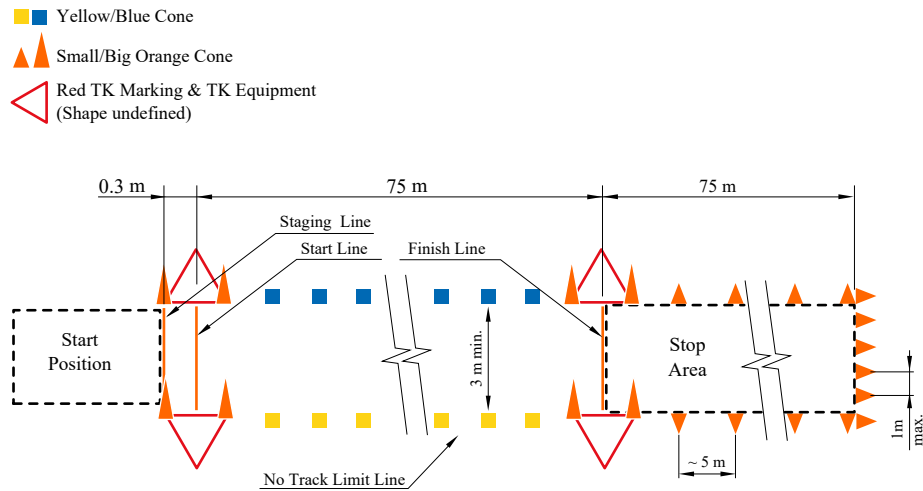


Figure 2: Acceleration

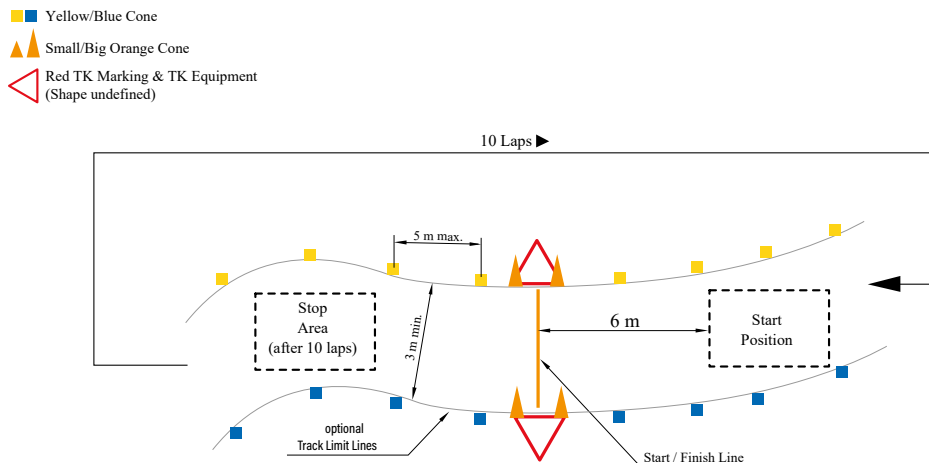


Figure 3: Trackdrive

## DE7 Vehicle Requirements and Restrictions

### DE7.1 Technical Inspection Sticker (IN1.3)

DE7.1.1 For the competition technical inspection sticker, a space 50 mm tall × 180 mm wide must be made available on the nose of the vehicle directly in front of the cockpit opening.

### DE7.2 [EV ONLY] Cell Temperature Monitoring Device (CTMD) (EV5.8.5)

DE7.2.1 [EV ONLY] The temperature measuring device DS1922T-F5 (iButton) will be provided by the officials and must be installed by the team. It is recommended to use an iButton holder (DS9093S) for mounting.

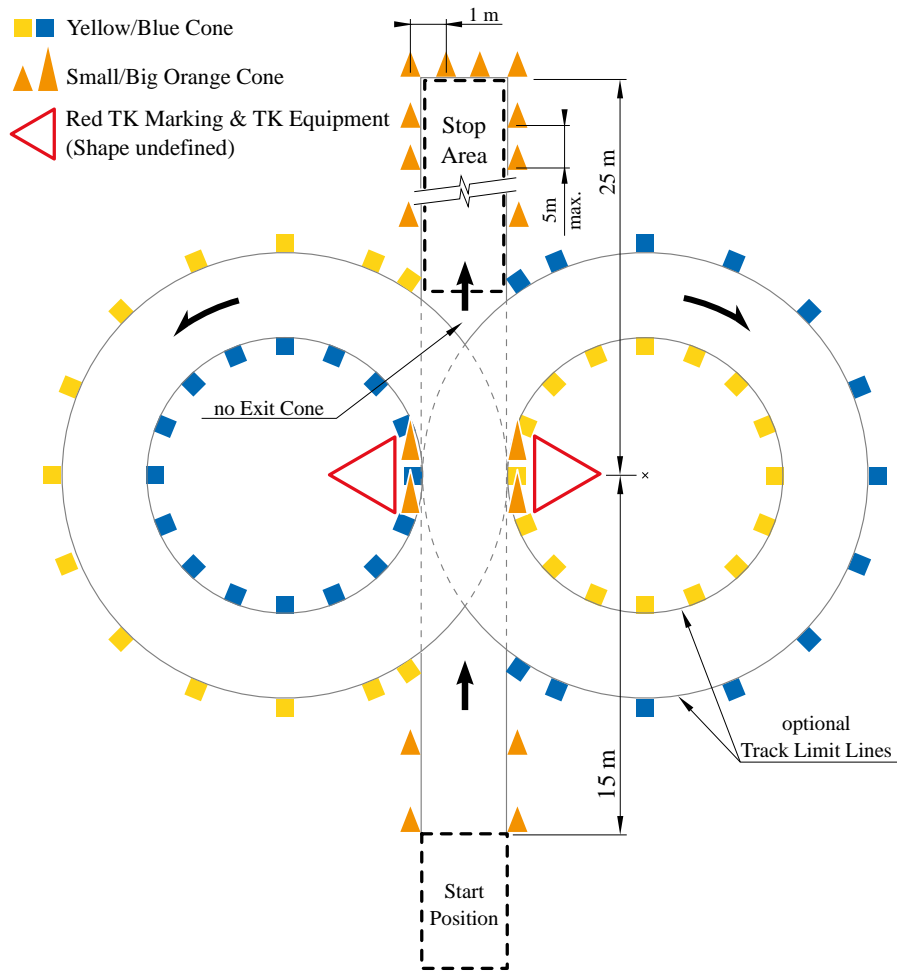


Figure 4: Skidpad base configuration according to rule D4.3

### DE7.3 Data Logger (EV 4.6 and T 14.3)

- DE7.3.1 A Data Logger (DL) described in the additionally published document "Data Logger Specification" will be mounted to the vehicle.
- DE7.3.2 The communication described in section DE7.4.9 must be traceable in the logs.
- DE7.3.3 Beside Remote Emergency System (RES) messages (see DE7.4.9), the messages defined in Table 4 must be provided to the DL with a cycle time of 100 ms each. Steering angle  $\delta$  and vehicle coordinate system is defined in figure 5.
- DE7.3.4 All signals are little-endian (Intel). Scale, if not defined, is 1.
- DE7.3.5 Messages 0x500 and 0x502 must be filled in any case. If some values are not directly available, they should be interpolated or calculated (i.e. target values). 0x501 depends on available sensor data.



CAN-ID	Name	Length	Format	Unit	Scale
0x500	DV driving dynamics 1	8 B			
	Speed_actual	bit 0-7	unsigned	km/h	
	Speed_target	bit 8-15	unsigned	km/h	
	Steering_angle_actual	bit 16-23	signed	°	0.5
	Steering_angle_target	bit 24-31	signed	°	0.5
	Brake_hydr_actual	bit 32-39	unsigned	%	
	Brake_hydr_target	bit 40-47	unsigned	%	
	Motor_moment_actual	bit 48-55	signed	%	
Motor_moment_target	bit 56-63	signed	%		
0x501	DV driving dynamics 2	6 B			
	Acceleration longitudinal	bit 0-15	signed	m/s <sup>2</sup>	$\frac{1}{512}$
	Acceleration lateral	bit 16-31	signed	m/s <sup>2</sup>	$\frac{1}{512}$
	Yaw rate	bit 32-47	signed	°/s	$\frac{1}{128}$
0x502	DV system status	5 B			
	AS_state_off		1		
	AS_state_ready		2		
	AS_state_driving	bit 0-2	3		
	AS_state_emergency_brake		4		
	AS_state_finish		5		
	EBS_state_unavailable		1		
	EBS_state_armed	bit 3-4	2		
	EBS_state_activated		3		
	AMI_state_acceleration		1		
	AMI_state_skidpad		2		
	AMI_state_trackdrive	bit 5-7	3		
	AMI_state_braketest		4		
	AMI_state_inspection		5		
	AMI_state_autocross		6		
	Steering_state	bit 8	bool		
	Service_brake_state_disengaged		1		
	Service_brake_state_engaged	bit 9-10	2		
Service_brake_state_available		3			
Lap_counter	bit 11-14	unsigned			
Cones_count_actual	bit 15-22	unsigned			
Cones_count_all	bit 23-39	unsigned			

**Table 4:** Message definition of logged general DV data

DE7.3.6 All signals mentioned in the team’s Autonomous System Form (ASF) have to be provided within the up to five messages with CAN-IDs 0x511 to 0x515. Each message can be up to 8 B of data length. Cycle time is 100 ms.

DE7.3.7 A valid dbc<sup>8</sup> file containing the message definition of the ASF messages must be uploaded with the ASF. It may be updated afterwards until the deadline mentioned in 2.

## DE7.4 Remote Emergency System (RES) (T14.4)

DE7.4.1 The RES that has to be used for the competition is a GF2000i-codec/T53R98 combination from Gross-Funk GmbH<sup>9</sup>.

<sup>8</sup>see [https://fsg.one/dbc\\_format](https://fsg.one/dbc_format) for more informations

<sup>9</sup>[https://f.fs-g.org/2017/important\\_docs/FSG2017\\_Gross-Funk\\_v20170126.pdf](https://f.fs-g.org/2017/important_docs/FSG2017_Gross-Funk_v20170126.pdf)



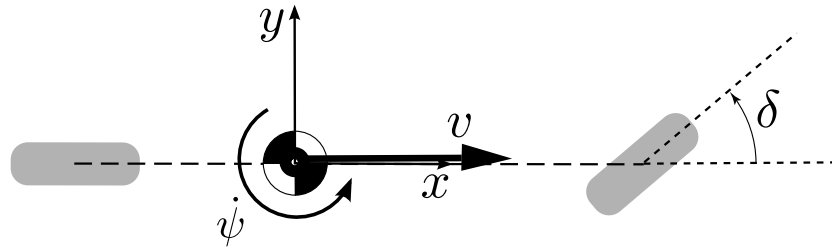


Figure 5: Bicycle model defining steering angle  $\delta$  (drawn in positive direction after "ISO 8855" coordinate system  $\Rightarrow z$  up) and speed  $v$ .

DE7.4.2 All RES must be of the latest 2022 hardware revision (with e-key). Older models must be sent in to Grossfunk in order to be upgraded. Details regarding the upgrade procedure will be published later on.

- SIL3 (EN61508) certified
- EMV certified
- communication in 430 MHz to 440 MHz band
- increased signal strength of 88 mW
- 12 V to 24 V supply voltage (0.26 A @12 V)
- 450 g, 173 mm  $\times$  113 mm  $\times$  35 mm
- IP20 (receiver) / IP65 (sender)



Figure 6: RES sender & receiver

DE7.4.3 Please contact Mr. Keller ([christian.keller@grossfunk.de](mailto:christian.keller@grossfunk.de)) at Gross-Funk for purchasing.

DE7.4.4 Regarding the increased signal strength, the BNetzA registration for Hockenheim will be provided by the officials.

DE7.4.5 The receiver includes a normally-open (NO) relay which must be part of shutdown circuit. It opens on switching shutdown, on signal loss, and on power loss. Maximum current rating is 4 A.

DE7.4.6 The CANopen interface of the receiver has the following properties:

- 1000 kbit/s, 125 kbit/s, 250 kbit/s and 500 kbit/s in standard configuration.

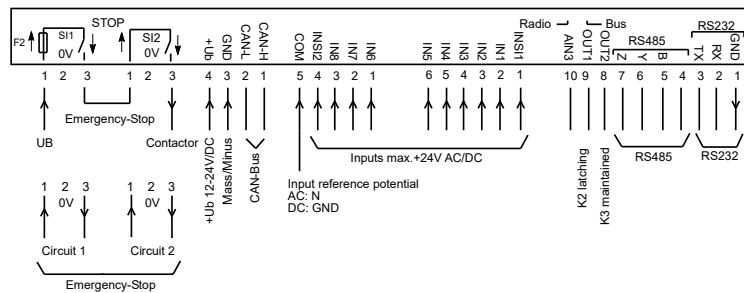


Figure 7: Connections at the RES receiver

- Cyclic PDOs containing states of switches (Go-signal) and radio
- Warns if signal loss detected (200 ms in advance to shutdown, contained in cyclic PDO)

DE7.4.7 The Node-ID and baud rate settings of the vehicle-side installed receiver can be configured with the external DIP switch:

DIP SW	1	2	3	4	5	6	7	8	Baud Rate
Node-ID	+1	+2	+4	+8	+16	+32	0	0	1 Mbit/s
Bit	0	1	2	3	4	5	1	0	125 kbit/s
							0	1	250 kbit/s
							1	1	500 kbit/s
	Node-ID						Baud Rate		

Table 5: DIP switch configuration RES.

DE7.4.8 The Node-ID has to be set to 0x011 at the competition. Only in severe cases, there will be an exception. Please give a detail problem description with the request.

DE7.4.9 The receiver is booted up and sends a message to signalize its initialization (NMT message with CAN-ID 0x700 + Node-ID and a single data byte 0x00). A CAN/CANopen master device must set the receiver to operational mode (NMT message CAN-ID = 0x000, byte 1 = 0x01 (requested state), byte 2 = addressed Node-ID or 0x00 for all). After setting to operational mode, the receiver starts sending a status message of 8 bytes containing PDOs 2000 - 2007 (one byte each, CAN-ID = 0x180 + Node-ID) every 30 ms.

DE7.4.10 Manually resetting the RES before sending the operational mode message may be used to check if the device is online (NMT message CAN-ID = 0x000, byte 1 = 0x80 (requested state), byte 2 = addressed Node-ID). This will be answered with the boot-up message.

DE7.4.11 Beside the CAN-IDs mentioned in DE7.4.9 and DE7.4.10, be aware not to use the CANopen-related IDs listed in Table 6 on the bus<sup>10</sup>.

DE7.4.12 System misbehavior and faulty logs caused by misuse of these messages eliminates the demand for a re-run and may lead to a Disqualified (DQ). Same counts for any kind of hardware manipulation to the sender and receiver or improper antennas modifications. In doubt, the logs available on the official DL (see Section DE7.3) count.

<sup>10</sup>[https://www.can-cia.org/fileadmin/resources/documents/brochures/co\\_poster.pdf](https://www.can-cia.org/fileadmin/resources/documents/brochures/co_poster.pdf)



Communication object	CAN-ID	Slave nodes
NMT node control	0x000	Receive only
Sync	0x080	Receive only
Emergency	0x080 + Node-ID	Transmit
TimeStamp	0x100	Receive only
PDO	0x180 + Node-ID	1. Transmit PDO
	0x200 + Node-ID	1. Receive PDO
SDO	0x580 + Node-ID	Transmit
	0x600 + Node-ID	Receive
NMT node monitoring	0x700 + Node-ID	Transmit
LSS	0x7E4	Transmit
	0x7E5	Receive

**Table 6:** Reserved message IDs for RES.

- DE7.4.13 The status of the switch (K2) and the button (K3) at the sender is contained in the PDO 2000 (bit 1 and 2) as well as on the digital outputs. The E-Stop is signaled by PDO 2000 bit 0 and PDO 2003 bit 7. PDO 2006 contains the radio quality (0% to 100%) whereas PDO 2007 summarizes several radio states, i.e. the pre-alarm radio communication interruption (bit 6, 200ms in advance to shutdown).
- DE7.4.14 Either K2 or K3 are allowed to be used to signalize the Go-signal for switching from "Ready" to "Driving" state, see T14.10, Figure 16. Both the CAN message or the digital outs can be used.