



FSG Competition Handbook 2021

2021-08-07

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Changelog

Rule	Version	Change
DE1.3.1	1.1	Changed event duration to six days
DE1.6	1.0	Added pandemic situation clarification
DE1.6.3	1.1	Changed team member count to eight.
DE1.6.3	1.2	No team members may be changed during the event.
DE1.6.4	1.1	No visitors for FSG 2021.
DE1.6.5	1.1	Clarified mask wearing requirements.
DE1.6.6	1.1	Added national id card carrying requirement.
DE1.6.7	1.1	Clarified SARS-CoV2 tracing app requirement.
DE1.6.8	1.1	Clarified camping situation.
DE1.6.9	1.1	Added information on pits on the marquee above pits.
DE1.7	1.2	Updated SARS-CoV-2 testing requirements
DE2.1.6	1.0	Remove rules question duration.
DE2.2.1	1.1	Updated slot count for FSG 2021.
DE2.2.2	1.0	New reserved slots.
DE2.3.1	1.1	Updated registration team members.
DE2.3.2	1.2	Added missing late TMD information.
DE2.3.4	1.0	Change registration fee refund policy.
DE2.5.3	1.1	Added standard terms to required uploads by team members.
DE2.5.4	1.0	Clarified Health Insurance Certificate (HIC) Upload requirements.
DE2.5.5	1.1	Standard terms procedure updated.
DE3.2.1	1.2	Added VAV, VAP deadlines.
DE3.2.4	1.1	Clarification on ASR Qualification (ASRQ)/Electrical System Officer Qualification (ESOQ).
DE4.1.7	1.1	Added information on on-site registration.
DE4.2.7	1.1	Changed loading time schedule.
DE4.4.2	1.2	Tents and pavillons are partially allowed for FSG21.
DE4.4.3	1.1	Changed lost & found pickup deadline.
DE4.4.4	1.1	Changed Confiscated goods pickup deadline.
DE4.5.1	1.0	No pickup of shirts and programs at the Event Control.
DE4.9.1	1.0	Removed Driver RFID wristbands.
DE4.10.2	1.1	Added information on virtual team briefings.
DE4.11	1.0	Technical inspection in pits.
DE4.12.1	1.1	Added driver registration procedure.
DE4.14	1.2	A few changes to match handout at event. Also an image was added.
DE4.14.6	1.1	Changed timekeeping tag return deadline.
DE4.15	1.1	Moved and updated charging section
DE5.1	1.1	Added additional information on online statics.
DE6.3.1	1.1	Remove DV Autocross data usage restriction.
DE7.2.1	1.1	Simplified temperature measuring process



Abbreviations

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



DE Formula Student Germany Competition Handbook 2021

DE1 General Information

DE1.1 One Site - Three Competitions

DE1.1.1 Three competitions will be organized by Formula Student Germany (FSG). These are for the Internal Combustion Engine Vehicle (CV) class, the Driverless (DV) class and the Electric Vehicle (EV) class. All three competitions will take place during the same week at the same location.

DE1.2 Applicable Rules

DE1.2.1 The competitions will be held in compliance with the "Formula Student Rules 2020".

DE1.3 Competition Dates and Place

DE1.3.1 FSG 2021 will be held from 16th until 21st of August 2021 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 8601¹.

DE1.5.2 The competition time zone is Central European Time (CET)² 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. Teams can expect a significantly scaled-down event in 2021.

¹https://en.wikipedia.org/wiki/ISO_8601

²https://en.wikipedia.org/wiki/Central_European_Time



- DE1.6.2 Changes to be expected may include (partially) virtual statics competitions, further reduction of participating teams or changes to the schedule and/or regulations governing the dynamic events.
- DE1.6.3 Teams will consist of up to eight team members. No team members may be exchanged for any reason after 2021-08-11 20:00 CEST.
- DE1.6.4 No visitors will be allowed for FSG 2021.
- DE1.6.5 Medical masks or FFP-2 masks must be worn in all indoor areas, including the pits and whenever a minimum distance of 1.5 m can not be maintained.
- DE1.6.6 A government issued national id card must always be carried on person and presented on request of the officials.
- DE1.6.7 The usage of an european SARS-CoV2 tracing app³ is mandatory.
- DE1.6.8 The campground provided by the Hockenheimring will most likely not be available during FSG 2021. We provide a list with possible alternatives on the FSG Website⁴.
- DE1.6.9 In order to ensure appropriate spacing between teams, all CV teams will have their pits on the marquee above pits. The vehicles will need to use the forklift elevator on the right side of the pit building. For moving equipment up and down from the marquee, a separate elevator on the left side of the pit building must be used.

DE1.7 SARS-CoV-2 testing requirements

- DE1.7.1 All SARS-CoV-2 documents must be uploaded by 18:00 CEST on the day before first entering the venue. All uploads must be made on the **My Account** section of the FSG Website. All uploads must be in english or german language.
- DE1.7.2 For team members that are **fully vaccinated** against SARS-CoV-2 (final dose before 2021-08-02, vaccine approved for use in germany⁵) the following applies:
 - They must upload their vaccination documentation in form of the EU Digital COVID Certificate <https://fsg.one/EUcert>.
 - They must upload a picture of the negative result of a SARS-CoV-2 self-test taken on the day before first entering the venue.
- DE1.7.3 For team members that **have recovered** from SARS-CoV-2 the following applies:
 - They must upload must upload a positive PCR test taken in the time range from 2021-02-20 until 2021-07-18 in form of the EU Digital COVID Certificate <https://fsg.one/EUcert>.
 - They must upload a picture of the negative result of a SARS-CoV-2 self-test taken on the day before first entering the venue.
- DE1.7.4 For **all other** team members one of the following two options must be followed.
 - One polymerase chain reaction (PCR) test, taken no longer than 72 h before the time of first arrival at the event venue.
 - Two consecutive antigen (rapid) tests, taken within 48 h to 72 h of each other, with the last one taken no more than 24 h before the time of first

³<https://fsg.one/cwa>

⁴<https://fsg.one/accomodation>

⁵<https://fsg.one/COVvaccines>



arrival at the event venue. One example when arriving on Monday would be to take the first test on Thursday or Friday and the second one on Sunday.

- DE1.7.5 All team members need to take supervised self tests during the event according to their individual schedule available in their **My Account** section. The schedule will be published one day in advance. Testing will take place near pit 47. Please be there for your test exactly at the scheduled time.
- DE1.7.6 A list of possible testing locations can be found on the FSG Website⁶.

DE1.8 Vehicle Shipping

- DE1.8.1 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.
- DE1.8.2 Customs and other paperwork like ATA Carnet⁷, inspecting shipments as well as reporting and documenting damage of the shipment is the sole responsibility of the team.
- DE1.8.3 Detailed vehicle shipping procedures are published on the competition website.
- DE1.8.4 Teams should upload their shipping documents to the competition website.

DE2 Registration

DE2.1 Team Registration

- DE2.1.1 The team registration will take place in the form of a quiz. There will be one quiz for all three classes. The topic for the quiz is: Basic engineering knowledge and Formula Student Rules 2020.
- DE2.1.2 The URL of the registration website is <https://reg.formulastudent.de>.
- DE2.1.3 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 DE3.1. 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.
- DE2.1.4 The quiz starts as defined in DE3.1.
- DE2.1.5 Only one question will be visible at a time and can only be answered once.
- DE2.1.6 Questions will have a fixed duration during which an answer has to be provided by the team.
- DE2.1.7 When entering the quiz late, depending on the delay, the first questions will not be visible anymore.
- DE2.1.8 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 DE3.1). Teams with less correct quiz answers will be sorted behind teams with more correct answers.

⁶<https://fsg.one/cov-test>

⁷https://en.wikipedia.org/wiki/ATA_Carnet



- DE2.1.9 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	DV(EV)	DV(CV)
vehicle numbers	001-199	201-399	401-499	501-599

- DE2.1.10 The quiz will close after the time to answer the last question has expired.
- DE2.1.11 No feedback if the answer was correct will be provided until the results are published on Saturday 2021-02-06 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 2021-02-06 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 2021-02-08 13:00 CET.
- DE2.1.12 Reserved slots (see DE2.2.2 and DE2.2.3) 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). Once this process is completed, the registration for those who missed the quiz will open. The period to pay the registration fee starts 2021-02-08 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 2021 is limited in total to 22 CV slots, 36 EV slots and 22 DV slots. Of these slots, 14 EV and eight DV slots are temporary, the participation of these teams can be cancelled on short notice in case of Covid-19 regulation changes.
- DE2.2.2 Reserved slots for the CV and EV class will each be assigned to the following teams:
- Three top teams from FSG 2019
 - Five top teams from latest World Ranking List⁸
- 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 Reserved slots for the DV class will be assigned to the following teams:
- Three top teams from FSG 2019
- DE2.2.4 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).

⁸<https://fs-world.org>



DE2.3 Registration Fee

- DE2.3.1 The registration fee is 1000€ and includes a 8-person team. Additional team member registration is not possible. The limit might be increased by FSG at a later time.
- DE2.3.2 Team members may register up to the defined maximum of participants after the TMD deadline for a fee of 100€ per participant.
- DE2.3.3 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.
- DE2.3.4 Registration fees are fully refundable when a team cancels its participation by 2021-08-02 13:00 CEST without any reason.

DE2.4 Waiting List & Withdrawals

- DE2.4.1 Teams on the waiting list may move to the participating list until 2021-08-02 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.

DE2.5 Team Member Designation (TMD)

- DE2.5.1 Participating team members must be assigned prior to the competition by the team captain or his deputies.
- DE2.5.2 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.
- DE2.5.3 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 HIC for Germany (e.g. travel insurance)
 - FSG standard terms
 - Current target degree of study
- DE2.5.4 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.

- DE2.5.5 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.

DE2.6 Visa for Participants

- DE2.6.1 All participants which passed the HIC-check, will find a personalized letter of invitation with a digital signature in their account overview.
- DE2.6.2 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 2021-02-05 13:00 CET and ends 336 hours (14 days) later.

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.
- DE3.2.3 [DV ONLY] In the Vehicle Status Video (VSV), the vehicle does not have to perform a full stop as mentioned in A5.6.2.
- DE3.2.4 ASRQ (A4.9.7) and ESOQ (A4.8.10) that consist of a bachelor certificate must have a course list added for study content traceability and check for relevant courses. For ASRQ that means also a nearly-finished bachelor curriculum (with relevant courses) is considered similar/equivalent.

DE4 Competition Site Organization

DE4.1 On-Site Registration

- DE4.1.1 Each team will be assigned a time slot for registering on-site.
- DE4.1.2 The on-site registration will take place near the south stands.
- DE4.1.3 The team captain will be handed the tickets of his team members and all other required documents for entering the venue.
- DE4.1.4 Tickets will only be handed out for team members with complete profiles on the FSG Homepage, including any SARS-CoV2 related uploads (see DE1.7).



Date	Deadline	Class
2021-03-05 13:00 CET	ESF Add Item Request (EAIR)	EV
2021-03-19 13:00 CET	Impact Attenuator Data (IAD)	ALL
2021-03-19 13:00 CET	Structural Equivalency 3D Model (SE3D)	ALL
2021-03-19 13:00 CET	Structural Equivalency Spreadsheet (SES)	ALL
2021-04-02 13:00 CEST	Autonomous System Form (ASF)	DV
2021-04-02 13:00 CEST	Electrical System Form (ESF)	EV
2021-04-16 13:00 CEST	SES Approval (SESA)	ALL
2021-06-04 13:00 CEST	Autonomous Design Report (ADR)	DV
2021-06-04 13:00 CEST	Business Plan Pitch Video (BPPV)	ALL
2021-06-04 13:00 CEST	Design Spec Sheet (DSS)	ALL
2021-06-04 13:00 CEST	Engineering Design Report (EDR)	ALL
2021-06-04 13:00 CEST	Magazine Uploads (MU)	ALL
2021-06-25 13:00 CEST	ASR Qualification (ASRQ)	DV
2021-06-25 13:00 CEST	Electrical System Officer Qualification (ESOQ)	EV
2021-06-25 13:00 CEST	Fuel Type Order (FTO)	CV
2021-06-25 13:00 CEST	Team Member Designation (TMD)	ALL
2021-07-09 13:00 CEST	Vehicle Status Video (VSV)	ALL
2021-07-30 13:00 CEST	Cost Report Documents (CRD)	ALL
2021-07-30 13:00 CEST	Final dbc file upload	DV
2021-08-09 23:59 CEST	Vehicle Appearance Video (VAV)	ALL
2021-08-09 23:59 CEST	Vehicle Appearance pdf (VAP)	ALL

Table 2: Document deadlines

- DE4.1.5 Tickets that were not handed out during on-site registration can be picked up by the team captain at event control. There will be no separate ticket center at the entrance.
- DE4.1.6 All questions regarding the registration procedure must be asked via the event helpdesk on the FSG Website⁹.
- DE4.1.7 The team must enter the competition site for unloading immediately after receiving their tickets and documents.

DE 4.2 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.
- 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 12m.

⁹<https://fsg.one/questions>



- 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 Saturday 2021-08-21 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 Saturday 2021-08-21 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 Tents or pavillons are allowed in the paddock area from Tuesday, 2021-08-17 12:00 CEST until Friday, 2021-08-20 23:59 CEST.
- DE4.4.3 Lost & found items must be picked up until Saturday 2021-08-21 20:00 CEST at event control.
- DE4.4.4 Confiscated goods must be picked up until Saturday 2021-08-21 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 Event Control

- DE4.5.1 Event shirts, programs and similar items will be delivered to the teams' pit.

DE 4.6 Welding

- DE4.6.1 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 4.7 Tyres

- DE4.7.1 FSG provides a tyre changing service.

DE 4.8 Fuel Station

- DE4.8.1 Open fuel containers are not permitted at the event.



- DE4.8.2 All fuel containers must be DOT approved.
- DE4.8.3 Refueling is only allowed at the fuel station.
- DE4.8.4 Waste oil is to be taken to the fuel station for disposal.

DE 4.9 [CV ONLY] Engine Test Area

- DE4.9.1 Engines may only be run in the designated engine test area during the opening times and only after passing the tilt test.

DE 4.10 Team Briefing (A6.3)

- DE4.10.1 Team and drivers briefings will be held virtually in the evening.
- DE4.10.2 All drivers and team captains need to watch the team briefing preceeding each dynamics day.

DE 4.11 Technical Inspection

- DE4.11.1 Technical inspection will take place in the pits.

DE 4.12 Driver Registration

- DE4.12.1 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 4.13 Technical Inspection Time Schedule

- DE4.13.1 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 4.14 Transponders / Timekeeping

- DE4.14.1 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).
- DE4.14.2 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.
- DE4.14.3 The area on the car will be cleaned (regular window cleaner) to apply velcro tape to mount RFID tags.
- DE4.14.4 If an RFID tag gets damaged, please contact Event Control. This will not result in a penalty.
- DE4.14.5 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.

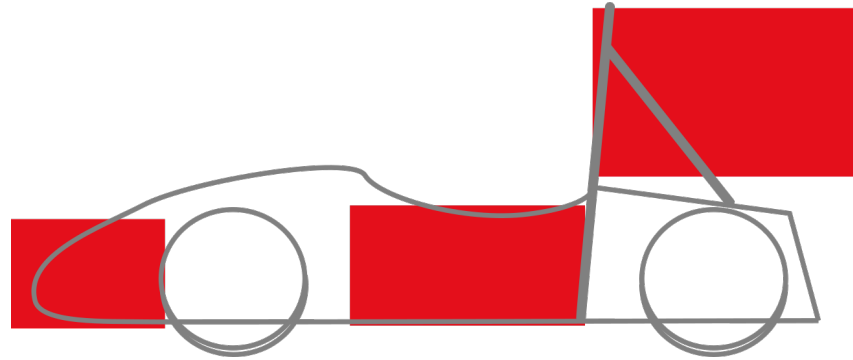


Figure 1: RFID Tag Placement Areas

DE4.14.6 After the competition, these tags must be returned to the event control by Saturday, 2021-08-21 18:00 CEST.

DE4.14.7 Live-timing is provided at <https://tk.formulastudent.de>. The shown data is unofficial.

DE 4.15 [EV ONLY] Charging

DE4.15.1 Charging will take place inside the pits.

DE4.15.2 During charging, the area in which the accumulator is placed must be fenced off. An Electrical System Officer (ESO) of the team must always be present.

DE4.15.3 400V, 50 Hz, 3-phase CEE charging connectors (3L+N+PE 6h) with 16 A and 32 A as well as 230 V, 50 Hz, 1-phase CEE 7/3 "Schuko" are available in the pits. Teams must bring their own extension cords.

DE 5 Static Events

DE 5.1 Online Statics

DE5.1.1 All statics will be held online on Thursday, 2021-08-12 and Friday, 2021-08-13.

DE5.1.2 The BPP (see S 1) will take place online via Zoom¹⁰.

DE5.1.3 The Engineering Design Event (see S 3) will take place online via Zoom¹⁰. Breakout rooms for different knowledge fields will be offered. Teams should join with a minimum of eight team members, one per field of knowledge. Teams should be able to show the vehicle via camera. Have in mind judges may use a browser-version of Zoom, then they can just see the camera view in fullscreen when no screensharing is active and nobody else is talking.

DE5.1.4 The Cost and Manufacturing Event (see S 2) will take place online, most likely via Zoom¹⁰. Breakout rooms for different knowledge fields will be offered. Teams should join with a minimum of six team members, in two groups of three each. One team member shall be able to show parts of the vehicle on request of the judges, one additional team member shall be responsible for the BOM and supporting material, respectively. Have in mind judges may use a browser-version of Zoom, then they can just see the camera view in fullscreen when no screensharing is active and nobody else is talking.

¹⁰<https://zoom.us>



DE5.1.5 Detailed information regarding the schedule will be published on FSG Website and FSG Today at a later time.

DE5.2 Detailed Bill of Material (DBOM)

DE5.2.1 For FSG 2021 a DBOM (see S2.5) for the "Suspension System" must be submitted.

DE5.3 Costed Bill of Material (CBOM)

DE5.3.1 For FSG 2021 a CBOM (see S2.6) for the "Electrical 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 missing from the queue.

DE6.2 [DV ONLY] 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."¹¹.
- 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 WEMAS¹² does not sell the cones to end customers, but they may be purchased from baustellenabsicherung24.de¹³.



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.

DE6.3 [DV ONLY] Autocross Procedure

- DE6.3.1 D6.3.2 does not apply.

¹¹<https://soppec.com/gb/construction-marking-spray-paints/13-tempo-tp.html>

¹²<https://www.wemas.de>

¹³<https://baustellenabsicherung24.de/leitkegel-titan-180-1934.html>



- Yellow/Blue Cone
- ▲ Small/Big Orange Cone
- ◁ Red TK Marking & TK Equipment (Shape undefined)

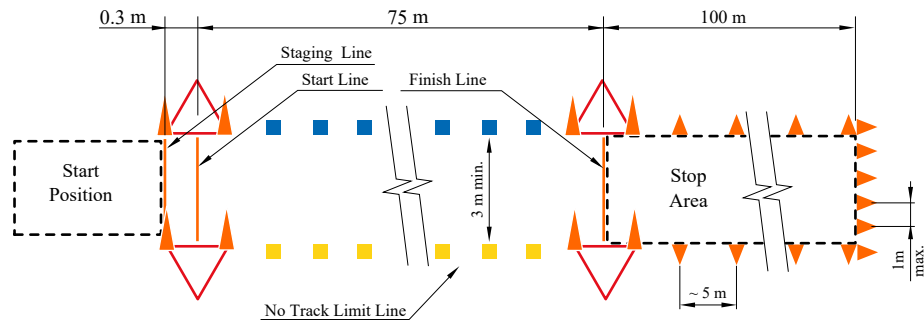


Figure 2: Acceleration

- Yellow/Blue Cone
- ▲ Small/Big Orange Cone
- ◁ Red TK Marking & TK Equipment (Shape undefined)

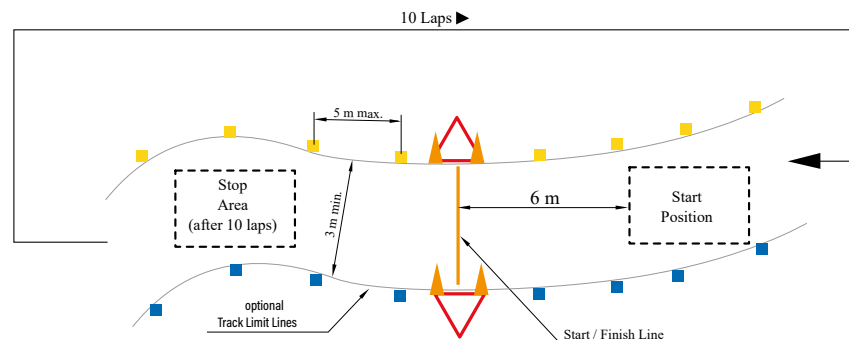


Figure 3: Trackdrive

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) (EV 5.8.5)

- 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.

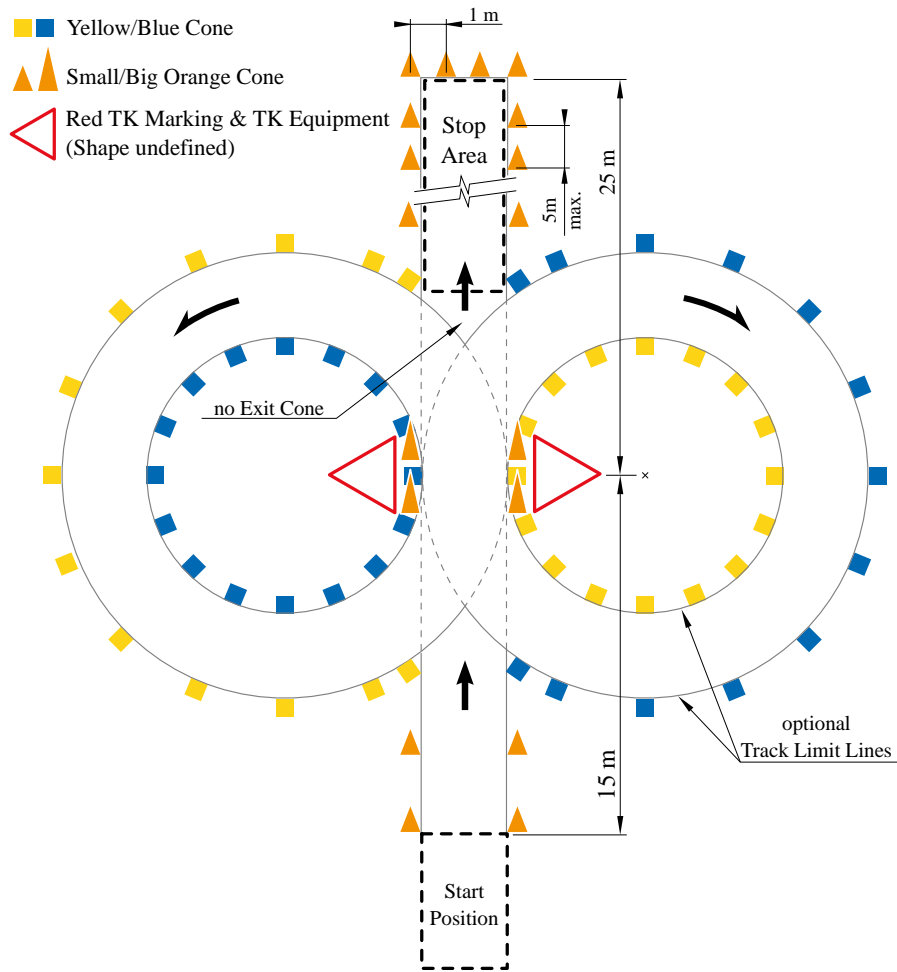


Figure 4: Skidpad base configuration according to rule D4.3

DE7.2.2 [DV ONLY] No temperature measuring device will be used for vehicles participating in FSD only.

DE7.3 [EV OR DV ONLY] Data Logger (EV 4.6 and DV1.3)

DE7.3.1 A Data Logger (DL) according to this specification will be used and provided by the officials as official measuring system according to EV4.6 and DV1.3.

DE7.3.2 The DL must be mounted according to EV4.6. It must be properly fastened and mounted at a location where it is protected from water. Its housing is of the type "Bopla Euromas II ET212" with outer dimensions of 100 x 100 x 57mm and a weight of 400 g. CAD-data of the DL can be found on the competition website.
14

DE7.3.3 The DL must be supplied by a voltage of 7 V DC to 60 V DC. It draws a maximum power of 9 W. It must be reasonably fused in the supply wiring.

DE7.3.4 The CAN bus interface operates on a data rate of 1 Mbit/s and is not terminated internally.



- DE7.3.5 The CAN message layout can be obtained from a dbc-file provided on the competition website. ¹⁴
- DE7.3.6 The Ethernet interface is according to the 100BASE-TX standard and requires a cable at least adhering to ISO/IEC 11801 Cat 5 with an RJ-45 connector. It must be easily accessible for data download.
- DE7.3.7 The sensor used by the DL is an Isabellenhütte IVT-500-U3-TOI-CAN2-12. ¹⁵
- DE7.3.8 The pinout of the connectors has to be according to Tables 4, 5 and 6.
- DE7.3.9 The DL is a single box with two LED and the following five connectors:

M10 nickel-plated brass bolts

- TS- in current path
- Must be connected fulfilling EV4.6.4
- **Maximum tightening torque: 22 Nm.**

Molex 39-01-2026 (DL-side)

- TS+ voltage measurement
- Must be connected fulfilling EV4.6.5

Binder 99 3431 202 04 (DL-side)

- Power and CAN interface
- Must power the DL according to EV4.6.6.
- Can be connected to a vehicle CAN bus to obtain status messages.
- Teams are advised to check the status messages, as they provide the status of the data logger.
- Missing data due to not checking the status messages will be treated as a fault of the team.
- Status messages are sent with a frequency of 50 Hz.
- Status messages contain maximum values (Voltage, Current, Power) of the respective time interval.
- Status messages are provided as a general reference only, only the data stored on the DL will be used for scoring.
- [DV ONLY] CAN Interfaces must be connected to the bus shared with the Remote Emergency System (RES).

Pin	Description
1	LV+
2	LV- (GND)
3	CANH
4	CANL

Table 4: DL side Power & CAN Connector (Binder 99 3431 202 04)

¹⁴<https://formulastudent.de/rules>

¹⁵<https://isabellenhuette.de/en/precision-measurement/standard-products/ivt-series>


Binder 99 3482 202 08 (DL-side)

- 100 Mbit/s Ethernet interface used for connecting to the DL
- Must be routed to a shielded RJ-45 plug with pinout specified in Table 6.
- The cable must be long enough to reach the top of the Main Hoop.
- CAUTION: provides 24 V passive Power over Ethernet (POE). Used to optionally power a Wifi access point. Do not connect directly to devices that do not support passive POE (e.g. Laptops) as it might damage them. Use a POE de-injector or a different cable.

Pin	Description
1	TX-
2	RX+
3	RX-
4	24 V (PoE+)
5	reserved (do not connect)
6	reserved (do not connect)
7	TX+
8	GND (PoE-)

Table 5: DL side Ethernet connector (Binder 99 3482 202 08)

Pin	Description
1	TX+
2	TX-
3	RX+
4	24 V (PoE+)
5	24 V (PoE+)
6	RX-
7	GND (PoE-)
8	GND (PoE-)

Table 6: Team/Officials side Ethernet connector (RJ-45)

Status	LED A	LED B
Idle, not logging	steady green	off
Logging	steady green	slowly blinking green
Error	blinking/steady red or off	blinking/steady red or off

Table 7: DL status LEDs

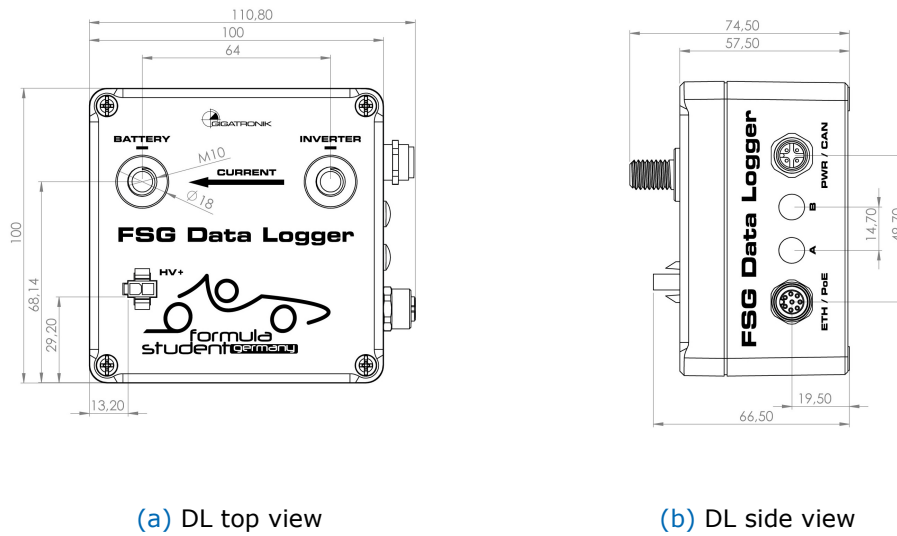


Figure 5: DL drawings (dimension in mm)

- DE7.3.10 At the competition, several Data Logger Download Station (DLDS) will be provided as self-service terminals.
- DE7.3.11 It is the responsibility of the team to ensure that the DL data from each event is made available to the officials by having it downloaded at a DLDS one hour after the closing of the respective event latest.
- DE7.3.12 Failure to make the data available within the specified time period due to the team's fault will result in the team not being scored for the respective event.
- DE7.3.13 Non-availability of DL data due to excessive electromagnetic emission by the vehicle will be treated as a power and voltage violation according to D9.4.1.
- DE7.3.14 [DV ONLY] The communication described in section DE7.4.8 must be traceable in the logs.
- DE7.3.15 [DV ONLY] Beside RES messages (see DE7.4.8), the messages defined in Table 8 must be provided to the DL with a cycle time of 100 ms each. Steering angle δ and vehicle coordinate system is defined in figure 6.

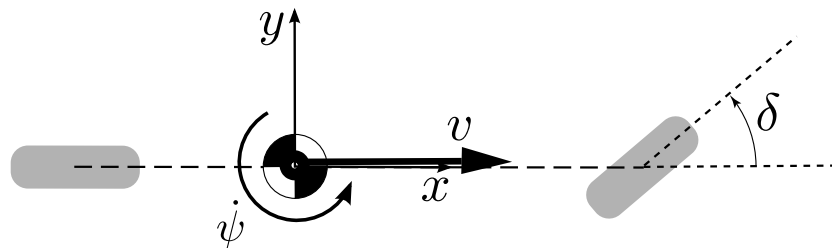


Figure 6: Bicycle model defining steering angle δ (drawn in positive direction after "ISO 8855" coordinate system \Rightarrow z up) and speed v .

- DE7.3.16 [DV ONLY] All signals are little-endian (Intel). Scale, if not defined, is 1.
- DE7.3.17 [DV ONLY] 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	%	
0x501	Motor_moment_target	bit 56-63	signed	%	
	DV driving dynamics 2	6 B			
	Acceleration longitudinal	bit 0-15	signed	m/s ²	$\frac{1}{512}$
	Acceleration lateral	bit 16-31	signed	m/s ²	$\frac{1}{512}$
0x502	Yaw rate	bit 32-47	signed	°/s	$\frac{1}{128}$
	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 8: Message definition of logged general DV data

DE7.3.18 [DV ONLY] 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.

DE7.3.19 [DV ONLY] A valid dbc¹⁶ 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.

DE 7.4 [DV ONLY] Remote Emergency System (RES)

DE7.4.1 The RES that has to be used for the competition is a GF2000i-codec/T53R98 combination from Gross-Funk GmbH¹⁷.

¹⁶see https://fsg.one/dbc_format for more informations

¹⁷https://f.fs-g.org/2017/important_docs/FSG2017_Gross-Funk_v20170126.pdf



- 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 × 113 mm × 35 mm
- IP20 (receiver) / IP65 (sender)



Figure 7: RES sender & receiver

- DE7.4.2 Please contact Mr. Keller (christian.keller@grossfunk.de) at Gross-Funk for purchasing.
- DE7.4.3 Regarding the increased signal strength, the BNetzA registration for Hockenheim will be provided by the officials.
- DE7.4.4 The receiver includes a normally-open (NO) relay which must be part of shut-down circuit. It opens on switching shutdown, on signal loss, and on power loss. Maximum current rating is 4 A.

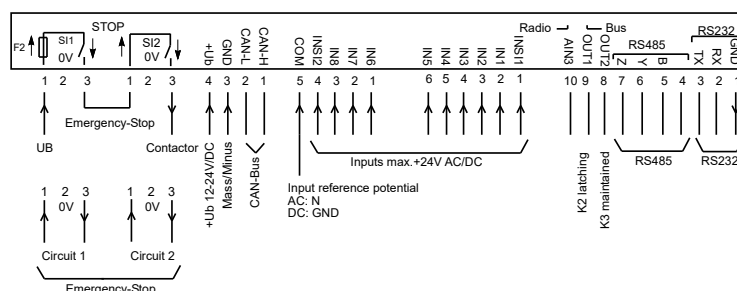


Figure 8: Connections at the RES receiver

- DE7.4.5 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.
 - 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)

DE7.4.6 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 9: DIP switch configuration RES.

- DE7.4.7 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.
- DE7.4.8 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.
- DE7.4.9 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.
- DE7.4.10 Beside the CAN-IDs mentioned in DE7.4.8 and DE7.4.9, be aware not to use the CANopen-related IDs listed in Table 10 on the bus¹⁸.

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 10: Reserved message IDs for RES.

- DE7.4.11 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.

¹⁸https://www.can-cia.org/fileadmin/resources/documents/brochures/co_poster.pdf



- DE7.4.12 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 signalized 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, 200 ms in advance to shutdown).
- DE7.4.13 Either K2 or K3 are allowed to be used to signalize the Go-signal for switching from "Ready" to "Driving" state, see DV2.4, Figure 21. Both the CAN message or the digital outs can be used.