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CHANGELOG

Rule	Version	Change
DE 2.1.5	1.0	Added time slots for quiz questions.
DE 2.1.6	1.0	Consequences of entering the quiz late added.
DE 2.1.9	1.0	Changed the end time of the quiz.
DE 2.1.10	1.0	No feedback for quiz until results are published.
DE 2.1.12	1.0	Added start of payment period.
DE 2.1.13	1.0	Team truck entrance no longer directly dependent on quiz order.
DE 4.1.2	1.0	"Team truck" queuing only with entrance pass.
DE 4.1.2	1.1	Typo corrected.
DE 4.1.9	1.0	Removed engine cranking instructions, in rules now.
DE 4.3.1	1.0	No self-propelled devices allowed.
DE 4.3.2	1.0	No pavilions allowed.
DE 4.3.4	1.1	Clarified confiscated goods pickup.
DE 4.3.5	1.0	Noise limit on the camp ground.
DE 4.10.1	1.0	Removed TI-Briefing.
DE 4.11.1	1.1	Added driver egress in the pits.
DE 4.11.2	1.1	Changed process of new pre-inspection appointment.
DE 4.12.1	1.0	Changed time of TI relocation.
DE 4.12.1	1.0	Deleted parking spots for tech inspection, moved parking spots for re-inspection to appropriate section.
DE 4.12.1	1.0	Deleted TI points that are not relevant anymore.
DE 4.13	1.1	Removed redundant rules about start time of time slots.
DE 4.13.1	1.0	Added pre-inspection to the list.
DE 4.13.2	1.0	Changed time slot durations.
DE 4.13.2	1.1	Added pre-inspection time slot duration.
DE 4.14.3	1.0	Mounting of TK transponders may not be changed.
DE 4.15.3	1.0	Moved re-inspection parking here.
DE 4.15.4	1.1	Removed inspection queue manager.
DE 4.16.2	1.1	Changed deadline for accumulator delivery.
DE 4.16.3	1.1	Changed penalty for accumulator delivery.
DE 4.16.4	1.1	Accumulator delivery must be registered.
DE 5.1.1	1.0	FSG19 DBOM added.
DE 5.2.1	1.0	FSG19 CBOM added.
DE 5.2.1	1.0	Removed Cost finals, in rules now.
DE 5.2.1	1.0	Removed Design event accumulator and cell presentation requirements, in rules now.
DE 5.3.1	1.0	Added BPP equipment.
DE 5.3.2	1.1	Added page restriction for Business Plan Executive Summary (BPES)
DE 6.1.4	1.0	Removed EV driver change additions (present in FS-D7.4.6).
DE 6.2.6	1.0	Removed skidpad change of track condition, in rules now.
DE 6.3.2	1.1	Added per-run DV autocross scoring.

Rule	Version	Change
DE 7.2	1.1	Added Cell Temperature Monitoring Device (CTMD) specification
DE 7.3.13	1.0	Moved Datalogger EMI Rule
DE 7.3.15	1.1	Adopted some signal names and added Autocross mission.
DE 7.4.4	1.1	Fixed typo.
DE 7.4.10	1.0	Change link to CANopen poster.
DE 7.4.11	1.1	Faulty logs are DQ not DNF.
DE 7.4.13	1.0	Removed DV AS clarifications added to rules.

ABBREVIATIONS

AAIR	ASF Add Item Request
ADR	Autonomous Design Report
ASF	Autonomous System Form
ASR	Autonomous System Responsible
ASRQ	ASR Qualification
BPES	Business Plan Executive Summary
BPP	Business Plan Presentation Event
CBOM	Costed Bill of Material
CEST	Central European Summer Time
CET	Central European Time
CRD	Cost Report Documents
CTMD	Cell Temperature Monitoring Device
CV	Internal Combustion Engine Vehicle
DBOM	Detailed Bill of Material
DL	Data Logger
DLDS	Data Logger Download Station
DNF	Did Not Finish
DQ	Disqualified
DSS	Design Spec Sheet
DV	Driverless Vehicle
EAIR	ESF Add Item Request
EBS	Emergency Brake System
EDR	Engineering Design Report

ESF	Electrical System Form
ESO	Electrical System Officer
ESOQ	Electrical System Officer Qualification
ETC	Electronic Throttle Control
EV	Electric Vehicle
FSG	Formula Student Germany
FTO	Fuel Type Order
HIC	Health Insurance Certificate
IAD	Impact Attenuator Data
LV	Low Voltage
LVMS	Low Voltage Master Switch
MU	Magazine Uploads
NMT	Network Management Protocol (CANopen)
PDO	Process Data Object (CANopen)
POE	Power over Ethernet
RES	Remote Emergency System
SDO	Service Data Object (CANopen)
SE3D	Structural Equivalency 3D Model
SES	Structural Equivalency Spreadsheet
SESA	SES Approval
TMD	Team Member Designation
TS	Tractive System
VSV	Vehicle Status Video

DE   FORMULA STUDENT GERMANY COMPETITION HANDBOOK 2019

DE 1   GENERAL INFORMATION

DE 1.1   One Site - Three Competitions

DE 1.1.1   Three competitions will be organized by Formula Student Germany (FSG). These are for the Internal Combustion Engine Vehicle (CV) class, the Driverless Vehicle (DV) class and the Electric Vehicle (EV) class. All three competitions will take place during the same week at the same location.

DE 1.2   Competition Dates and Place

DE 1.2.1   FSG 2019 will be held from 5th until 11th of August 2019 in Hockenheim, Germany.

DE 1.3   Competition Website

DE 1.3.1   The URL of the FSG competition website is `https://www.formulastudent.de`.

DE 1.4   Date and Time Format

DE 1.4.1   The competition date/time format is "YYYY-MM-DD hh:mm" according to ISO 8601[1].

DE 1.4.2   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.

DE 1.4.3   The time of the competition website is the official time for all deadlines and decisions: `https://www.formulastudent.de/time`.

DE 1.5   Vehicle Shipping

DE 1.5.1   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 1.5.2   Customs and other paperwork like ATA Carnet[3], inspecting shipments as well as reporting and documenting damage of the shipment is the sole responsibility of the team.

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[1] `https://en.wikipedia.org/wiki/ISO_8601`
[2] `https://en.wikipedia.org/wiki/Central_European_Time`
[3] `https://en.wikipedia.org/wiki/ATA_Carnet`

DE 1.5.3   Detailed vehicle shipping procedures are published on the competition website.

DE 1.5.4   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. There will be one quiz for all three classes. The topic for the quiz is: Formula Student Rules 2019 and basic engineering knowledge.

DE 2.1.2   The URL of the registration website is `https://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   Only one question will be visible at a time and can only be answered once.

DE 2.1.5   Questions will have a fixed duration during which an answer has to be provided by the team. The duration will be 5 min to 15 min.

DE 2.1.6   When entering the quiz late, depending on the delay, the first questions will not be visible anymore.

DE 2.1.7   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 2.1.8   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

DE 2.1.9   The quiz will close after the time to answer the last question has expired.

DE 2.1.10   No feedback if the answer was correct will be provided until the results are published. After the result are published, teams have one hour to hand in protest.

DE 2.1.11   Reserved slots (see DE 2.2.2 and DE 2.2.3) will be assigned to the teams based on past achievements and home countries. All remaining and unused reserved slots will be assigned to all other teams, with regard to their quiz result.

DE 2.1.12   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 DE 2.3). Once all slots have been filled, all additional teams will be placed on a waiting list (see DE 2.4).

Once this process is completed, the registration for those who missed the quiz will open. The period to pay the registration fee starts 2019-02-04 18:00 CET.

DE 2.1.13   The technical inspection order at the competition will be based on the quiz result.

DE 2.2   Registration Slots

DE 2.2.1   FSG 2019 is limited in total to 60 CV slots, 40 EV slots and 18 DV slots.

DE 2.2.2   Reserved slots for the CV and EV classes will each be assigned to the following teams:

- Five top teams from FSG 2018

- Eight top teams from latest World Ranking List (`https://fs-world.org`)

Additional to these teams the following international slots will be reserved for each the CV and EV class:

- Three teams from Australia, China, Japan and New Zealand

- Three teams from Canada and the United States of America

- Three teams from Europe (see DE 2.2.5), besides Germany

- Three teams from the rest of the world

In case a team with a reserved international slot doesn't pay the registration fee in time (see DE 2.3) its slot is given to the next team of its world region.

DE 2.2.3   Reserved slots for the DV class will be assigned to the three top teams from FSG 2018.

DE 2.2.4   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 DE 2.1.9).

DE 2.2.5   Europe is defined to consist of the following countries:
Albania, Andorra, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Kazakhstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Malta, Moldova, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russia, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, Vatican City.

DE 2.3   Registration Fee

DE 2.3.1   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 DE 3.2). 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.

DE 2.3.2   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.

DE 2.3.3   Registration fees are not refundable for any reason.

DE 2.4   Waiting List & Withdrawals

DE 2.4.1   Teams on the waiting list may move to the participating list until 2019-07-19 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.

DE 2.4.2   Teams on the waiting list are required to submit all documents and forms by the same deadlines as teams on the participating list.

DE 2.4.3   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   Team Member Designation (TMD)

DE 2.5.1   Participating team members must be assigned prior to the competition by the team captain or his deputies.

DE 2.5.2   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.

DE 2.5.3   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 Health Insurance Certificate (HIC) for Germany (e.g. travel insurance)
- Current target degree of study

DE 2.5.4   All participants who passed the HIC-check, will find personalized standard terms in their account overview. This document must be printed out, signed by the participant and brought to the on-site registration in alphabetical order by the team captain.

DE 2.6   Visa for Participants

DE 2.6.1   All participants which passed the HIC-check, will find a personalized letter of invitation with a digital signature in their account overview.

DE 2.6.2   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.

DE 3   IMPORTANT DATES

DE 3.1   Team Registration

DE 3.1.1   Team registration (see DE 2.1) for all teams starts on 2019-02-01 13:00 CET and ends 336 hours (14 days) later.

DE 3.2   Deadlines

DE 3.2.1   All required documents and information must be uploaded to the competition website by the team captain and/or his/her deputies by the following deadlines:

Date	Deadline	Class
2019-03-15 13:00 CET	ASF Add Item Request (AAIR)	DV
2019-03-15 13:00 CET	Electronic Throttle Control (ETC)	CV
2019-03-15 13:00 CET	ESF Add Item Request (EAIR)	EV
2019-03-15 13:00 CET	Impact Attenuator Data (IAD)	ALL
2019-03-15 13:00 CET	Structural Equivalency 3D Model (SE3D)	ALL
2019-03-15 13:00 CET	Structural Equivalency Spreadsheet (SES)	ALL
2019-04-12 13:00 CEST	Autonomous System Form (ASF)	DV
2019-04-12 13:00 CEST	Electrical System Form (ESF)	EV
2019-04-12 13:00 CEST	SES Approval (SESA)	ALL
2019-05-31 13:00 CEST	Autonomous Design Report (ADR)	DV
2019-05-31 13:00 CEST	Business Plan Executive Summary (BPES)	ALL
2019-05-31 13:00 CEST	Design Spec Sheet (DSS)	ALL
2019-05-31 13:00 CEST	Engineering Design Report (EDR)	ALL
2019-05-31 13:00 CEST	Magazine Uploads (MU)	ALL
2019-06-14 13:00 CEST	ASR Qualification (ASRQ)	DV
2019-06-14 13:00 CEST	Electrical System Officer Qualification (ESOQ)	EV
2019-06-14 13:00 CEST	Fuel Type Order (FTO)	CV
2019-06-14 13:00 CEST	Team Member Designation (TMD)	ALL
2019-06-28 13:00 CEST	Vehicle Status Video (VSV)	ALL
2019-07-19 13:00 CEST	Cost Report Documents (CRD)	ALL
2019-07-19 13:00 CEST	Final dbc file upload	DV

Table 2: Document deadlines

DE 3.2.2   All documents must comply with a maximum size of 40 MB.

DE 4   COMPETITION SITE ORGANIZATION

DE 4.1   Entering the Competition Site

DE 4.1.1   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.

DE 4.1.2   Only when the entrance passes are filled out the driver may queue the "team truck" at the entrance gate.

DE 4.1.3   The total length of the "team truck" including a possible trailer must not exceed 12 m.

DE 4.1.4   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.

DE 4.1.5   Afterward the "team truck" must be moved to the designated parking spaces outside the pit area.

DE 4.1.6   It is not possible to drive to the pit area again with the "team truck" during the event before loading on Sunday.

DE 4.1.7   On Sunday 2019-08-11 the team is entitled to enter the pits once with the "team truck" for a maximum of 30 min for the purpose of loading.

DE 4.1.8   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 2019-08-07 until Sunday 2019-08-11 11:00 CEST.

DE 4.1.9   All teams must leave the parking area by Monday 2019-08-12 10:00 CEST.

DE 4.2   Announcements

DE 4.2.1   All announcements can be found on the competition website `https://www.formulastudent.de/today/`.

DE 4.3   Competition Site

DE 4.3.1   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.

DE 4.3.2   No tents or pavilions are allowed on the entire competition site.

DE 4.3.3   Lost & found items must be picked up until Sunday 2019-08-11 20:00 CEST at event control.

DE 4.3.4   Confiscated goods must be picked up until Sunday 2019-08-11 18:00 CEST in the dynamic area near the "Dekra House". Confiscated items that are not picked up in time will not be kept.

DE 4.3.5   No music speakers or devices with a total power over 20 W are allowed on the camp site at any time during the competition. Teams generating more noise may be excluded from the competition.

DE 4.4   Event Control

DE 4.4.1   The team captain will receive a package containing shirts, programs, etc. at event control. Large teams may bring one or two extra people to help carrying.

DE 4.5   Welding

DE 4.5.1   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**

DE 4.6.1   FSG provides a tyre changing service.

DE 4.7   **Fuel Station**

DE 4.7.1   Open fuel containers are not permitted at the event.

DE 4.7.2   All fuel containers must be DOT approved.

DE 4.7.3   Refueling is only allowed at the fuel station.

DE 4.7.4   Waste oil is to be taken to the fuel station for disposal.

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

DE 4.8.1   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   **Driver Registration**

DE 4.9.1   Drivers must register personally at the event control where they have to show their valid driver's license and a student ID.

DE 4.10   **Team Briefing (A 6.3)**

DE 4.10.1   [EV ONLY] All ESO are required to attend the team briefing.

DE 4.10.2   Each team member required in a certain briefing will receive a RFID-wristband which will be scanned at the entrance to log him/her as attendant on the present day.

DE 4.10.3   Drivers without the RFID scan cannot participate at the dynamic events of this particular day.

DE 4.11   **Pre-Inspection**

DE 4.11.1   Pre-inspection and driver egress will be conducted in the pit, where the technical inspectors will visit the teams according to a predesignated time slot based on the registration quiz order.

DE 4.11.2   A team that is not present or ready can arrange a new appointment at the entrance of the dynamic area, but there can be no guarantee that the new slot will be before the start of the dynamic events.

DE 4.11.3   Pre-inspection must be completed latest before the tilt test.

DE 4.11.4   The driver egress is mandatory for all drivers. Before participating in a dynamic event, the driver must have passed the egress test.

DE 4.12   Technical Inspection

DE 4.12.1   On Monday 2019-08-05 the mechanical, electrical and driverless inspection will take place in the pits. From Tuesday 2019-08-06 on it will take place in the technical inspection area.

DE 4.13   Technical Inspection Time Schedule

DE 4.13.1   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 4.13.2   The length of these slots is 2 hours for accumulator inspection, 1.5 hours for mechanical inspection, 0.33 hours for pre-inspection and 2.5 hours for electrical inspection. [DV ONLY] For driverless inspection the electrical inspection is extended by 0.25 hours.

DE 4.13.3   A team can enter the inspection bay 5 min in advance of the start time.

DE 4.13.4   If a team shows up later than 15 min after the start time, it will loose its time slot and will be put last in the respective inspection order.

DE 4.13.5   After the end of a time slot a team has 5 min to clear the inspection bay for the next team.

DE 4.14   Transponders / Timekeeping

DE 4.14.1   Three RFID-tags will be mounted on the vehicle during technical inspection using velcro tape. The size of each tag is 104 mm x 33 mm.

DE 4.14.2   After the competition, these tags must be returned to the event control.

DE 4.14.3   The 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.

DE 4.14.4   Live-timing is provided at `http://tk.formulastudent.de`. The shown data is unofficial.

DE 4.15   Re-Inspection

DE 4.15.1   The re-inspection for the mechanical, electrical and driverless inspection will take place in the technical inspection area and the accumulator re-inspection will take place in the accumulator tent.

DE 4.15.2   Designated parking spots for re-inspection are located inside the technical inspection area.

DE 4.15.3   Repairing the vehicle at these parking spots and parking the vehicle anywhere else in the area is prohibited.

DE 4.15.4   The re-inspection will be handled according to the "first-in-first-out-principle".

DE 4.15.5   The re-inspection slots have no fixed starting times, but are limited to 30 min duration.

DE 4.15.6   If more than 30 min is needed the team must queue again for another re-inspection slot.

DE 4.16   **[EV ONLY] Accumulator Inspection**

DE 4.16.1   Accumulator inspection will take place in the accumulator tent.

DE 4.16.2   All TS accumulators need to be brought in the accumulator tent until 13:00 CEST for DV and 20:00 CEST for EV on the day the team is allowed to enter the competition site.

DE 4.16.3   If a team misses the before mentioned deadline, a penalty of 10 points is deducted of its overall score for every commenced 12 hours up to a maximum total of 30 penalty points.

DE 4.16.4   The team has to register the accumulator delivery at the accumulator tent.

DE 5   STATIC EVENTS

DE 5.1   Detailed Bill of Material (DBOM)

DE 5.1.1   For FSG 2019 a DBOM (see S 2.5) for the "Brake System" and "Steering System" must be submitted.

DE 5.2   Costed Bill of Material (CBOM)

DE 5.2.1   For FSG 2019 a CBOM (see S 2.6) for the "Engine and Drivetrain" must be submitted.

DE 5.3   Business Plan Presentation Event (BPP)

DE 5.3.1   Data projectors or screens with VGA and HDMI (type A) input connectors will be provided for video signal transmission. Teams planning to use audio or other presentation equipment are responsible for bringing it themselves.

DE 5.3.2   The BPES must not exceed one page DIN A4.

DE 6   DYNAMIC EVENTS

DE 6.1   [EV ONLY] Dynamic Area and Dynamic Vests (D 1.2)

DE 6.1.1   The charging area is a separated dynamic area including separate entrance restrictions.

DE 6.1.2   Only three members per team may enter the charging area at the same. One of them must be a Electrical System Officer (ESO) or Autonomous System Responsible (ASR), respectively.

DE 6.1.3   Inside the charging area, team members must not wear any conductive jewelery and must not wear any conductive objects of any kind which could touch the accumulator.

DE 6.1.4   CEE charging connectors 16 A, 32 A and CEE 7/3 "Schuko" are available in the charging area.

DE 6.2   [DV ONLY] Track Marking

DE 6.2.1   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 5 m. 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.

DE 6.2.2   All lines are spray painted with the chalk-based marking paint "Soppec - Tempo T.P."[4].

DE 6.2.3   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).

DE 6.2.4   The manufacturer WEMAS[5] does not sell the cones to end customers, but they may be purchase from baustellenabsicherung24.de[6].

big orange cone two white stripes	small orange cone single white stripe	small yellow cone single black stripe	small blue cone single white stripe
WEMAS 307.610500.00.00	WEMAS 400.000013.00.00	WEMAS 400.000013.01.10	WEMAS 400.000043.00.00
285 mm × 285 mm × 505 mm 1.05 kg	228 mm × 228 mm × 325 mm 0.45 kg		

Table 3: Cone specs

DE 6.2.5   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

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[4]http://soppec.com/en/worksite-markers/13-tempo-tp.html
[5]http://www.wemas.de
[6]https://baustellenabsicherung24.de/leitkegel-titan-180-1934.html

different colored surface, etc.) on or close to the track which will not be removed by the officials.

- 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.

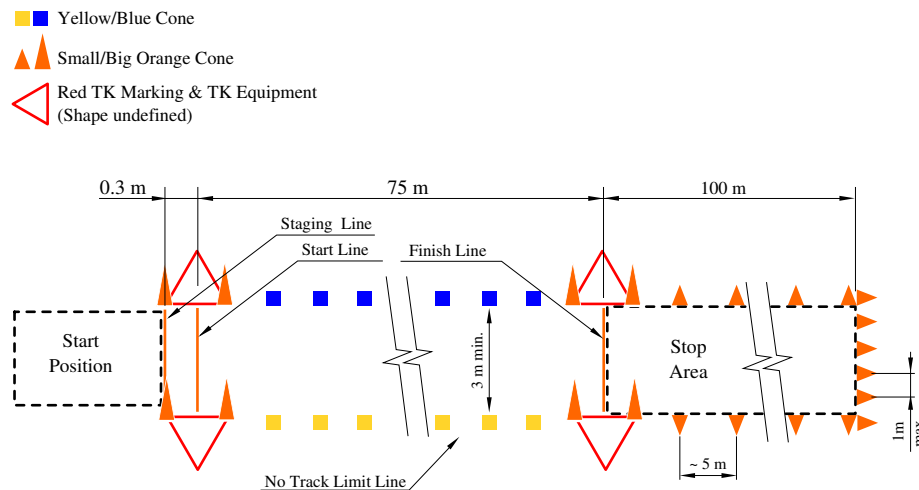DE 6.2.6   Figures 1, 2 and 3 visualize the track layout descriptions given in D 4.3, D 5.1, and D 8.1.
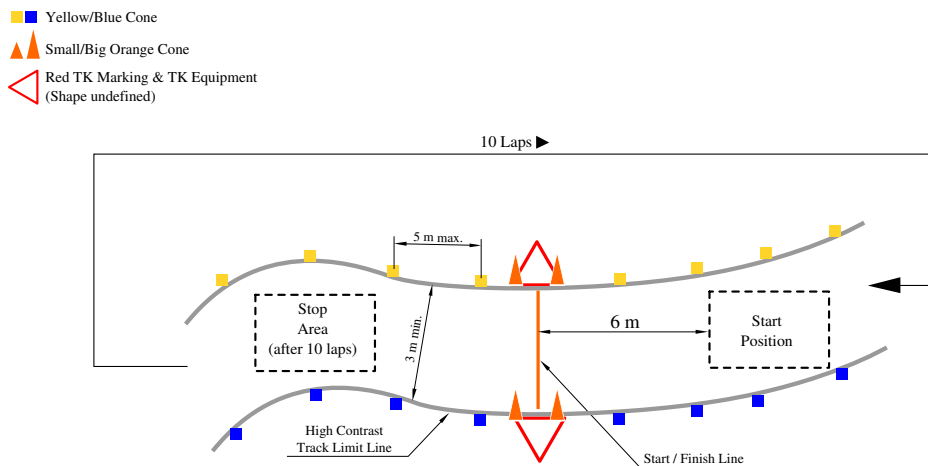

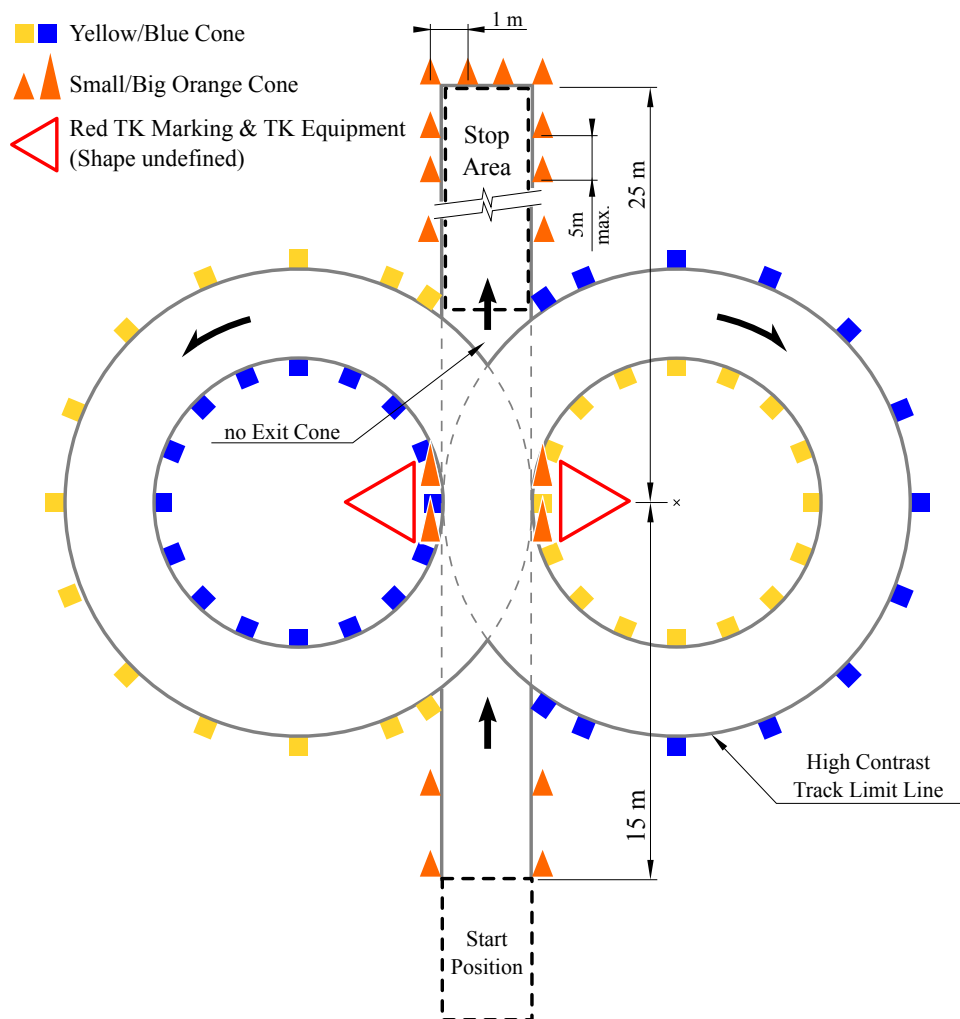Figure 1: Acceleration

Figure 2: Trackdrive

Figure 3: Skidpad base configuration according to rule D 4.3

DE 6.3   [DV ONLY] Autocross scoring

DE 6.3.1   Supplementary to D 6.5.2, each run is scored separately. That means for *n* runs

$$AUTOCROSS\_SCORE_{total} = max(AUTOCROSS\_SCORE_1,$$
$$avg\,(AUTOCROSS\_SCORE_1..AUTOCROSS\_SCORE_n))$$

where T_{team} and T_{max} are also derived per run.

DE 6.3.2   D 6.3.3 does not apply.

DE 7 VEHICLE REQUIREMENTS AND RESTRICTIONS

DE 7.1 Technical Inspection Sticker (IN 1.3)

DE 7.1.1 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.

DE 7.2 [EV ONLY] Cell Temperature Monitoring Device (CTMD) (EV 5.8.5)

DE 7.2.1 A Cell Temperature Monitoring Device (CTMD) has to be installed inside the Tractive System (TS) accumulator container. It consists of a single box which is connected to three temperature sensors. The CTMD as well as the temperature sensors are provided by the officials.

DE 7.2.2 The CTMD must be properly fastened and mounted inside the accumulator container. A step file showing the dimensions will be provided on the competition website.

DE 7.2.3 Every TS accumulator container must be equipped with a separate CTMD.

DE 7.2.4 The exceptions listed in EV 5.4.3 are extended to the CTMD.

DE 7.2.5 The CTMD must be supplied by a voltage of 7 V DC to 60 V DC. It must be directly connected to the Low Voltage Master Switch (LVMS) and must be reasonably fused in the supply wiring. It draws a maximum power of 2.5 W.

DE 7.2.6 The CTMD's CAN bus interface has to be directly connected to the corresponding datalogger CAN bus interface.

DE 7.2.7 The CAN bus interface operates on a data rate of 1Mbit/s and is not terminated internally.

DE 7.2.8 The CAN message layout can be obtained from a dbc-file provided on the competition website prior to the competition.

DE 7.2.9 NTC Thermistors (Vishay NTCAFLEX05) are used for the measurement. This sensors will be glued in the accumulator during accumulator inspection. The position will be defined in the Electrical System Form (ESF) and in accumulator inspection.

DE 7.2.10 The CTMD is a single box with the following four connectors:

- 3x Molex Mini-Fit Jr. 39-30-0020 (CTMD-side)
    - Connector to each temperature sensor
    - Sensors, connectors and wiring harness will be provided by the officials
- 1x Molex Mini-Fit Jr. 39-30-0040 (CTMD-side)
    - Power and CAN interface

DE 7.2.11 The pinout of the Low Voltage (LV) connector has to be according to Table 4.

DE 7.2.12 The position of the connectors can be deducted from Figure 4.

DE 7.2.13 Teams are advised to check the status messages, as they provide the status of the CTMD.

DE 7.2.14 Missing data due to not checking the status messages will be treated as a fault of the team.

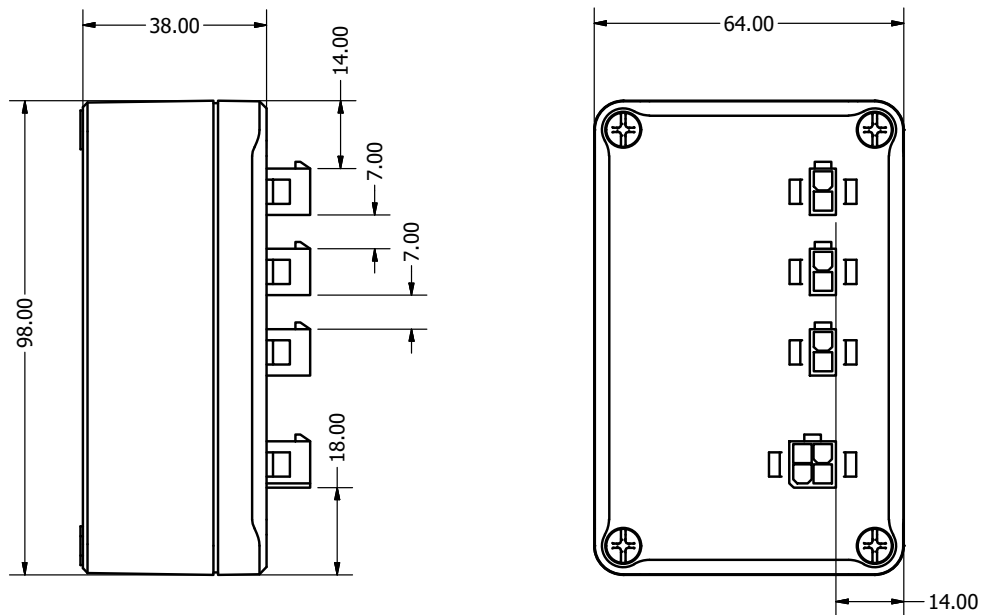| Pin	Description
1	LV+
2	LV-
3	CANH
4	CANL

Table 4: Pinning LV connector CTMD

Figure 4: Dimensions of the CTMD

DE 7.2.15   Status messages are sent with a frequency of 5 Hz.

DE 7.2.16   The temperature data will be sent from the CTMD to the Data Logger (DL) (see EV 4.6) and stored there. This data will be used for scoring.

DE 7.2.17   [DV ONLY] DV teams can request to use an iButton monitoring device instead. This 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.

DE 7.3   [EV OR DV ONLY] Data Logger (EV 4.6 and DV 1.3)

DE 7.3.1   A DL according to this specification will be used and provided by the officials as official measuring system according to EV 4.6 and DV 1.3.

DE 7.3.2   The DL must be mounted according to EV 4.6. 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. [7]

DE 7.3.3   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.

DE 7.3.4   The CAN bus interface operates on a data rate of 1 $^{\text{Mbit}}/_{\text{s}}$ and is not terminated internally.

DE 7.3.5   The CAN message layout can be obtained from a dbc-file provided on the competition website. [7]

DE 7.3.6   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.

DE 7.3.7   The sensor used by the DL is an Isabellenhütte IVT-500-U3-TOI-CAN2-12. [8]

DE 7.3.8   The pinout of the connectors has to be according to Tables 5, 6 and 7.

DE 7.3.9   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 EV 4.6.4
- **Maximum tightening torque:** 22 Nm**.**

Molex 39-01-2026 (DL-side)

- TS+ voltage measurement
- Must be connected fulfilling EV 4.6.5

Binder 99 3431 202 04 (DL-side)

- Power and CAN interface
- Must power the DL according to EV 4.6.6.
- 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.

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[7] https://formulastudent.de/rules

[8] https://isabellenhuette.de/en/precision-measurement/standard-products/ivt-series

- [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 5: DL side Power & CAN Connector (Binder 99 3431 202 04)

Binder 99 3482 202 08 (DL-side)

- $100\,\mathrm{Mbit/s}$ Ethernet interface used for connecting to the DL

- Must be routed to a shielded RJ-45 plug with pinout specified in Table 7.

- 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 6: 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 7: 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 8: DL status LEDs
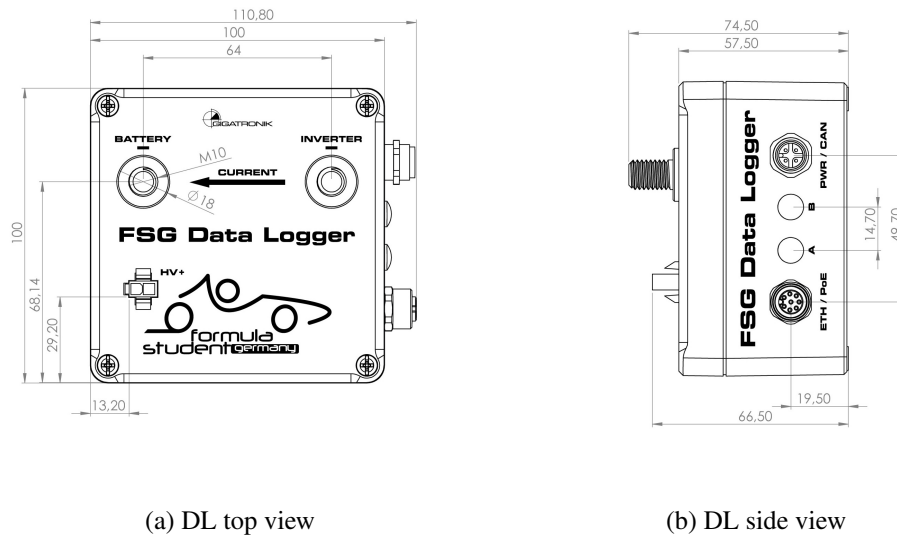
(a) DL top view

(b) DL side view

Figure 5: DL drawings (dimension in mm)

DE 7.3.10   At the competition, several Data Logger Download Station (DLDS) will be provided as self-service terminals.

DE 7.3.11   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.

DE 7.3.12   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.

DE 7.3.13   Non-availability of DL data due to excessive electromagnetic emission by the vehicle will be treated as a power and voltage violation according to D 9.4.1.

DE 7.3.14   [DV ONLY] The communication described in section DE 7.4.8 must be traceable in the logs.

DE 7.3.15   [DV ONLY] Beside RES messages (see DE 7.4.8), the messages defined in Table 9 must be provided to the data logger with a cycle time of 100 ms each. Steering angle δ and vehicle coordinate system is defined in figure 6.

DE 7.3.16   [DV ONLY] All signals are little-endian (Intel). Scale, if not defined, is 1.

DE 7.3.17   [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	%	
	Motor_moment_target	bit 56-63	signed	%	
0x501	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	$\frac{1}{512}$
	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 9: Message definition of logged general DV data

DE 7.3.18   [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.

DE 7.3.19   [DV ONLY] A valid dbc[9] 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.

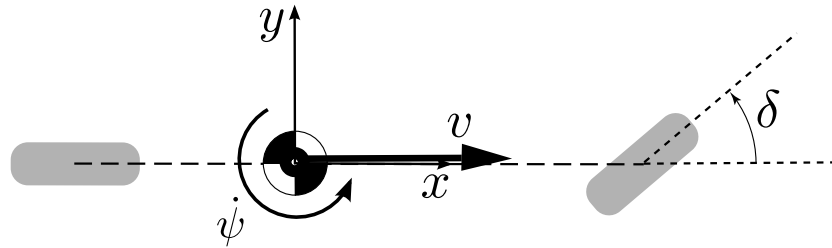[9]see https://fsg.one/dbc_format for more informations

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

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

DE 7.4.1   The RES that has to be used for the competition is a GF2000i-codec/T53R98 combination from Gross-Funk GmbH[10].

- 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 7: RES sender & receiver

DE 7.4.2   Please contact Mr. Keller (christian.keller@grossfunk.de) at Gross-Funk for purchasing.

DE 7.4.3   Regarding the increased signal strength, the BNetzA registration for Hockenheim will be provided by the officials.

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[10]https://f.fs-g.org/2017/important_docs/FSG2017_Gross-Funk_v20170126.pdf

DE 7.4.4   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.
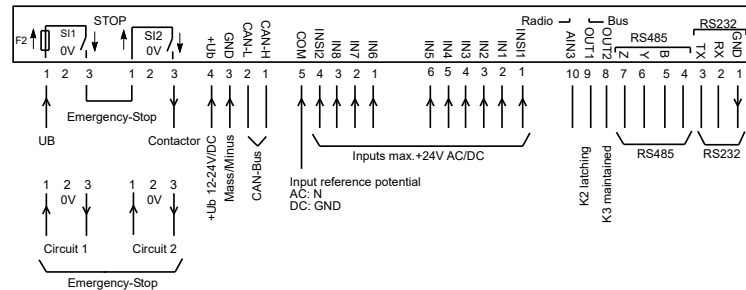

Figure 8: Connections at the RES receiver

DE 7.4.5   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)

DE 7.4.6   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 10: DIP switch configuration RES.

DE 7.4.7   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.

DE 7.4.8   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.

DE 7.4.9   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 = adressed Node-ID). This will be answered with the boot-up message.

DE 7.4.10   Beside the CAN-IDs mentioned in DE 7.4.8 and DE 7.4.9, be aware not to use the CANopen-related IDs listed in Table 11 on the bus[11].

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 11: Reserved message IDs for RES.

DE 7.4.11   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).

DE 7.4.12   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).

DE 7.4.13   Either K2 or K3 are allowed to be used to signalize the Go-signal for switching from "Ready" to "Driving" state, see DV 2.4, Figure 21. Both the CAN message or the digital outs can be used.

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[11]https://www.can-cia.org/fileadmin/resources/documents/brochures/co_poster.pdf