System Requirements Specification

Automotive System Cluster

(ELC and ACC)
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1 Adaptive exterior lighting system

1.1 General

1.1.1 Short description of the development scope

The exterior lighting system contains the following user functions:

**AL-2:** Turn Signal: Control of the driving direction indicators of the vehicle in dependence of the pitman arm and/or the hazard warning light switch.

**AL-54:** Low beam headlights: Control of the low beam headlights in dependence of the light rotary switch and the daytime running light setting.

**AL-55:** Adaptive high beam: Control of the high beam headlights in dependence of the high beam switch and the detection of advancing vehicles.

1.2 Functions

1.2.1 Turn Signal (direction blinking, hazard warning light)

**AL-40:** Direction Blinking Left: When moving the pitman arm in position "turn left" the vehicle flashes all left direction indicators (front left, exterior mirror left, rear left) synchronically with pulse ratio bright to dark 1:1.

**AL-144:** The maximum deviation of the pulse ratio should be below the cognitive threshold of a human observer.

**AL-147:** A deviation of the pulse ratio with less than 0.5% is accepted as cognitive threshold of a human observer.

**AL-145:** The reaction time between the activation of the pitman arm and the beginning of the first flashing cycle should be below the cognitive threshold of a human observer.

**AL-146:** A deviation of less than 0.05s is accepted as cognitive threshold of a human observer.

**AL-104:** Tip-Blinking Left: If the driver moves the pitman arm for less than 0.5 seconds in position "tip-blinking left", all left direction indicators (see AL-40) should flash for three flashing cycles.

**AL-129:** If the driver activates the pitman arm in another direction or activates the hazard warning light switch during the three flashing cycles of the tip-blinking, the tip-blinking cycle must be stopped and the requested flashing cycle must be released (direction of turn Signal, tip-blinking, hazard warning light)

**AL-105:** If the driver holds the pitman arm for more than 0.5 seconds in position "tip-blinking left", flashing cycles are released for all direction indicators on the left (see AL-40) until the pitman arm leaves the position "tip-blinking left".

**AL-101:** Direction blinking right and tip-blinking right: Analogous to the left side.

**AL-89:** Direction blinking: For USA and CANADA, the daytime running light must be dimmed by 50% during direction blinking on the blinking side.

**AL-109:** If the driver activates the pitman arm during the three flashing cycles of tip-blinking again, only the current flashing cycle is completed.

**AL-41:** Hazard Warning Light: As long as the hazard warning light switch is released, all direction indicators flash synchronically. If the ignition key is in the ignition lock, the pulse ratio is bright to dark 1:1. If the ignition key is not in the lock, the pulse ratio is 1:2.

**AL-148:** The adaptation of the pulse ratio must occur at the latest after two complete flashing cycles.
Note: The reduction of the pulse performed due to energy saving reasons, such that, in case of an emergency situation, the hazard warning light is active as long as possible before the car battery is empty.

When hazard warning is deactivated and the pit arm is in position “direction blinking left” or “direction blinking right”, the direction blinking cycle should be released.

If tip-blinking was activated shortly before deactivation of the hazard warning, this is not considered during the deactivation of the hazard warning.

The duration of a flashing cycle is 1 second.

Also after 1000 flashing cycles the cumulated deviation must not exceed 0.05s.

A flashing cycle (bright to dark) must always be completed, before a new flashing cycle can occur.

Note: By the fact, that a flashing cycle must always be completed, a "switching" behavior of the indicator is avoided. Thus, for example a change of the pitman arm from “tip-blinking” to “direction blinking” or back has no visible effect.

1.2.2 Low beam headlights (including daytime running light and cornering light)

The low beam headlights can be activated by several conditions:

(a) The driver activates the low beam headlights by turning the light rotary switch to position “exterior lights on”.

(b) With activated daytime running light, the low beam headlights are activated after starting the engine. The daytime running light remains active as long as the ignition key is in the ignition lock. With activated ambient light the low beam headlights remain active according to AL-48.

(c) If the light rotary switch is in position “automatic”, the low beam headlights are activated as soon as the exterior brightness is lower than a threshold S1. If the exterior brightness exceeds a threshold S2 (with S2> S1), the low beam headlights are deactivated. In any case, the low beam headlights remain active at least for 3 seconds.

(d) With activated ambient light, the low beam headlights are activated as soon as at least one door of the vehicle is opened and the exterior brightness outside the vehicle is lower than the threshold S1. The low beam headlights are deactivated as soon as all vehicle doors are closed again.

(e) With activated ambient light, the low beam headlights are activated as soon as the engine is switched off and the ignition key is pulled of the ignition lock. The low beam headlights (as ambient light) are deactivated as soon as none of the following actions occur within the next 30 seconds.
- Opening or closing a door
- Insertion or removal of the ignition key

With activated darkness switch (only armored vehicles) the ambient lighting is not activated.

Cornering light: If the low beam headlights are activated and direction blinking is requested, the cornering light is activated, when the vehicle drives slower than 10 km/h. 10 seconds after passing the corner (i.e. the direction blinking is not active any more for 10 seconds), the cornering light is switched in a duration of 1 second (gentle fade-out).

With activated darkness switch (only armored vehicles) the cornering light is not activated.
1.2.3 Adaptive high beam headlights

AL-15: If the light rotary switch is in position "auto", the adaptive high beam headlights are activated by moving the pitman arm to the back.

AL-110: The operational availability of the adaptive high beam headlights is indicated by a symbol in the instrument cluster.

AL-111: If adaptive high beam headlight is activated and the vehicle drives faster than 30 km/h and no light of an advancing vehicle is recognized by the camera, the street should be illuminated within 2 seconds according to the characteristic curve AL-112 (activated high beam headlights).

AL-16: If the camera recognizes the lights of an advancing vehicle, an activated high beam headlights is reduced to low beam headlight within 0.5 seconds by reducing the area of illumination to 65 meters due to an adjustment of the headlight position as well as by reduction of the luminous strength.

AL-17: If no advancing vehicle is recognized any more, the high beam illumination is restored within 2 seconds.

AL-38: The light illumination area of the high beam headlight is within 100m and 300m, depending on the vehicle speed (see characteristic curve AL-112).

AL-112: **Figure:** Characteristic curve of the high beam headlight illumination depending on the vehicle speed

AL-120: If the pitman arm is moved again in the horizontal neutral position, the adaptive high beam headlight is deactivated. The illumination of the street is reduced immediately (i.e. without gentle fade-out) to low beam headlights.

1.2.4 Manual high beam headlight

AL-118: The headlamp flasher is activated by pulling the pitman arm, i.e. as long as the pitman arm is pulled, the high beam headlight is activated.

AL-119: If the light rotary switch is in positions "off" or "exterior light on", pulling the pitman arm causes the activation of the high beam headlight with a fixed illumination area of 220 m.
1.2.5 Fault detection
1.2.5.1 Defective headlights
AL-100: If a defective illuminant is detected, the information about the defective illuminant is transmitted to the instrument cluster.
AL-102: The prioritization of the display in the instrument cluster is determined by the instrument cluster.

1.2.5.2 Over- and subvoltage
AL-115: A subvoltage is present if the voltage in the vehicle electrical system is less than 8.5V.
AL-116: With subvoltage, the adaptive high beam headlight is not available. If the light rotary switch is in position “auto” and the pitman arm is pulled, the high beam headlight is activated (see AL-119).
AL-121: With subvoltage the ambient light is not available.
AL-122: With subvoltage the cornering light is not available.
AL-123: An overvoltage is present if the voltage in the vehicle electrical system is more than 14.5V.
AL-124: With overvoltage, the headlights must be activated with \((100 - (\text{voltage} - 14.5) \times 20)\ %\) accepting a tolerance of +/-10 % of the actual power by means of PWM (pulse width modulation).
AL-125: Note: The reduction of the power serves the protection of the illuminant (protection from "burning out").
AL-126: With overload, the illumination area requirements do not need to be respected (see AL-38 and AL-16).

1.3 Properties, Constraints and Interfaces
1.3.1 Lighting Elements
AL-64: The following figure schematically shows the positions of the exterior lighting elements of the vehicle.
AL-62: Figure: Position of the exterior lighting elements

AL-63: The following lighting elements are installed:
AL-65: Position A (left and right):

![Diagram of exterior lighting elements]
- Direction indicator (blinker)
- Headlights for low beam and high beam headlight
- Lamp for cornering light left or right (integrated in front bumper)

AL-67: Position B (left and right):
- Direction indicator (blinker)

AL-68: Position C (left and right):
- Direction indicator (blinker)
- Brake lamp
- Tail lamp

AL-66: Details about the design of the lighting elements are regulated by the directive 93/92/EEC.

1.3.2 User Interface and Settings

AL-69: In the context of the exterior lighting system, the following user controls and options are available:

1.3.2.1 Rotary Light Switch

AL-71: Figure: rotary light switch

AL-72: The rotary light switch has the following positions: (see AL-55)

AL-73:
- Off
- Auto (automatic position)
- Exterior light on

1.3.2.2 Settings of the instrument cluster

AL-75: In the instrument cluster settings the function “daytime running light” can be activated or deactivated in the menu “Settings, Vehicle settings, Daytime running light”.

AL-76: In the instrument cluster settings the function “ambient lighting” can be activated or deactivated in the menu “Settings, Vehicle settings, Ambient lighting”.

1.3.2.3 Pitman Arm

AL-78: The control lever attached to the steering column is called pitman arm.

AL-79: The pitman arm can have the following positions:

AL-80: By pushing away from the driver: Permanent activation of the high beam or adaptive high beam (with pitman arm engaged).

AL-81: By pulling towards the driver: Temporary activation of the high beam (without engaging, so-called flasher).

AL-82: By moving up or down: Temporary or permanent activation of the direction indicator to the left or right. The temporary activation happens by a deflection of about 5°, the permanent activation (engage) by about 7° deflection.
1.3.2.4 Hazard Warning Light Switch
AL-84: Figure: Hazard Warning Light Switch

1.3.2.5 Darkness Switch (only armored vehicles)
AL-127: Figure: Darkness Switch

AL-88: The darkness switch is mounted in the area of the upper control field.

1.3.3 Sensors and Actuators
1.3.3.1 Camera
AL-132: The camera has a resolution of 800 x 600 pixels.
AL-136: The frame rate of the camera is 60 Hz.
AL-133: The camera shoots in a color range of 390-1000 nm, i.e. it partly covers the near infrared region.
AL-134: After activation of clamp 30 (ignition on), the camera performs a self-test. 2 seconds after activation of clamp 30 dependable picture information is given.
AL-135: The camera sends the data via LVDS.
AL-137: The resolution of the camera signal is 24 bits (8 bits each RGB).

1.3.4 Headlight Technology
AL-93: Low beam illuminant must be halogen.
AL-97: Low beam illuminant must be LED.
AL-96: Low beam illuminant must be Xenon.

1.3.5 Functional Safety
AL-142: The function of the low beam light is classified as safety-relevant in the sense of ISO 26262.
AL-143: The classification of the system "adaptive exterior light" is ASIL B.

2 Speed Control System
2.1 General
2.1.1 Short description of the development scope
FA-15: The speed control system includes the following user functions:
FA-58: Adaptive Cruise Control: The vehicle maintains the distance to the preceding vehicle including braking until a full standstill and starting from a standstill.
FA-16: Cruise Control: The vehicle automatically maintains a set speed.
Distance Warning: The vehicle warns the driver visually and/or acoustically if the vehicle is closer to the car ahead than allowed by the safety distance.

Emergency Brake Assist: The vehicle decelerates in critical situations to a full standstill.

Speed Limit: The vehicle does not exceed a set speed.

Sign Recognition: The vehicle sets the speed limit automatically according to the recognized signs.

Brake Assist: On heavy pushing of the brakes, the vehicle increases the braking process.

Traffic Jam Following: The vehicle accelerates from a standstill when the preceding vehicle departs.

2.2 Functions

2.2.1 Adaptive Cruise Control

FA-2: The adaptive cruise control system includes the following user functions

FA-3: (a) When the driver enables the cruise control (by pulling the cruise control lever or by pressing the cruise control lever up or down), the vehicle maintains the set speed if possible.

FA-4: (b) If the distance to the vehicle ahead falls below the specified speed-dependent safety distance (see FA-78), the vehicle brakes automatically. The maximum deceleration is 5m/s².

FA-5: (c) If the maximum deceleration of 5 m/s² is insufficient to prevent a collision with the vehicle ahead, the vehicle warns the driver by two acoustical signals (0.1 seconds long with 0.2 seconds pause between) and by this demands to intervene.

FA-6: (d) If the distance to the preceding vehicle increases again above the speed-dependent safety distance, the vehicle accelerates with a maximum of 2 m/s² until the set speed is reached.

FA-99: (e) If the speed of the preceding vehicle decreases below 20 km/h, the distance is set to 2.5s, down to a standstill. When both vehicles are standing the absolute distance is regulated to 2m. When the preceding vehicle is accelerating again, the distance is set to 3s. This distance is valid until the vehicle speed exceeds 20 km/h, independent of the user’s input via the distance level (turning the ACC lever).

FA-78: By turning the cruise control lever, the distance to be maintained to the vehicle ahead can be selected. Three levels are available: 2 seconds, 2.5 seconds and 3 seconds. The desired level only applies within the velocity window > 20 km/h. Below this level, the system autonomously sets the distance.

2.2.2 Distance warning

FA-86: The adaptive cruise control system has to calculate the distance (time) to the vehicle ahead and has to issue the following warnings depending on the calculated value:

FA-81: • Acoustic alarm if the actual distance is less than (current speed / 3.6) * t.

FA-82: • Visual warning if the actual distance is less than (current speed / 3.6) * t².

2.2.3 Emergency Brake Assistant

FA-85: The emergency brake assistant must be available in the following speed windows: 0 - 60 km/h, for emergency braking to stationary obstacles, 0 – 120 km/h on moving obstacles.
The time necessary to perform braking to standstill is determined by the value for the maximum deceleration. If an object is ahead of the vehicle and the time until an impact is less or equal to the time until a standstill + ta seconds, an acoustic signal is issued and the brakes are activated by x%. If the time until an impact is less or equal to the time until a standstill + ta2 seconds (with ta> ta2), the brake is activated by y%. If the time until an impact is less or equal to the time until standstill then the brake is activated 100%.

2.2.4 Cruise Control

FA-19: The cruise control is activated using the cruise control lever:

FA-20: (a) If the cruise control is deactivated and the cruise control lever is pulled, the last chosen speed set point should be adopted as set speed.

FA-21: (b) If no speed was set since the last start of the motor and the cruise control lever is pulled, the current vehicle speed is used as speed set point. If the current vehicle speed is below 20km/h, the speed is not adopted as speed set point and the cruise control is not activated.

FA-22: (c) If the cruise control is deactivated and the cruise control lever is moved up or down, the current vehicle speed is used as speed set point.

FA-23: The current vehicle speed is maintained towards the speed set point by setting acceleration and deceleration.

FA-24: As long as the cruise control is activated, the vehicle maintains the current vehicle speed of without the driver having to press the accelerator or the brake pedal.

FA-25: If the driver pushes the cruise control lever up to the first resistance level and the cruise control is activated, the speed set point of the cruise control is increased by the value N.

FA-59: If the driver pushes the cruise control lever above the first resistance level (beyond the pressure point) and the cruise control is activated, the cruise control speed set point is increased to the next ten’s place (e.g. starting speed 57 km/h → speed set point 60 km/h)

FA-26: If the driver pushes down the cruise control lever with cruise control activated up to the first resistance level, the speed set point of the cruise control is reduced by N.

FA-60: If the driver pulls down the cruise control lever with activated cruise control beyond the first resistance level (through the pressure point), the speed set point is reduced to next lower ten’s place (e.g. starting speed 57 km/h → speed set point 50 km/h).

FA-61: If the driver pushes up the cruise control lever with activated cruise control through the first resistance level (beyond the pressure point) and holds it there for a time > t seconds, the speed set point of the cruise control is increased every t seconds to the next ten’s place (e.g. starting speed 57 km/h, t = 2 seconds → after holding 2 seconds, speed set point 60 km/h, after holding 4 seconds, speed set point 70 km/h, after holding 6 seconds, speed set point 80 km/h, etc.)

FA-63: If the driver pushes down the cruise control lever with activated cruise control through the first resistance level (beyond the pressure point) and holds it there for a time > t seconds, the target speed of the cruise control is reduced every t seconds to the next lower ten’s place (e.g. starting speed 57 km/h, t = 2 seconds → after holding 2 seconds, speed set point 50 km/h, after holding 4 seconds, speed set point 40 km/h, after holding 6 seconds, speed set point 30 km/h, etc.)

FA-62: If the driver pushes up the cruise control lever with activated cruise control within the first resistance level (not beyond the pressure point) and holds it there for a time > t seconds, the target speed of the cruise control is increased every t seconds by the value N (e.g. starting speed 57 km/h, N = 1 km/h, t = 2 seconds → after holding 2 seconds, speed set point 58 km/h, etc.)

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after holding 4 seconds, speed set point 59 km/h, after holding 6 seconds, speed set point 60 km/h, etc.).

**FA-64:** If the driver pushes down the cruise control lever with activated cruise control within the first resistance level (not beyond the pressure point) and holds it there for a time > t seconds, the target speed of the cruise control is reduced every t seconds by the value N (e.g. starting speed 57 km/h, N = 1 km/h, t = 2 seconds \(\rightarrow\) after holding 2 seconds, speed set point 56 km/h, after holding 4 seconds, speed set point 55 km/h, after holding 6 seconds, speed set point 54 km/h, etc.).

**FA-27:** If the driver pushes the gas pedal and by the position of the gas pedal more acceleration is demanded than by the Cruise Control, the acceleration setting as demanded by the driver is adopted.

**FA-28:** By pushing the brake or the hand brake, the cruise control is deactivated until it is activated again.

### 2.2.5 Speed Limit

**FA-30:** The speed limit function is activated by means of the speed limiting lever.

**FA-31:** The current vehicle speed is adopted as speed limit.

**FA-32:** As long as the speed limit function is activated, the current speed must not exceed the set speed limit.

**FA-65:** If the driver presses the speed limiting lever upwards within the first resistance stage and speed limit function is activated, the speed limit is increased by N.

**FA-66:** If the driver presses the speed limiting lever upwards above the first resistance stage (i.e. over the pressure point) and speed limit function is activated, the speed limit is increased to the next ten’s place (e.g. starting speed limit 57 km/h \(\rightarrow\) target speed limit 60 km/h).

**FA-67:** If the driver presses the speed limiting lever downwards within the first resistance stage and speed limit function is activated, the speed limit is decreased by N.

**FA-68:** If the driver presses the speed limiting lever downwards beyond the first resistance stage (i.e. beyond the pressure point) and speed limit function is activated, the speed limit is decreased to the next ten’s place (e.g. starting speed limit 57 km/h \(\rightarrow\) target speed limit 50 km/h).

**FA-35:** By pressing the gas pedal beyond 90% the speed limit is temporarily deactivated.

**FA-36:** When the pressure on the gas pedal decreases below 90%, the speed limit is automatically activated again.

**FA-37:** An active speed limit can be deactivated by means of the speed limiting lever.

#### 2.2.5.1 Sign Detection

**FA-77:** If a road sign indicating a speed limit of F km/h according to the local traffic laws (maximum permissible speed) is recognized when driving with activated speed limit function, the speed limit is set to the value F.

### 2.2.6 Braking assistance

**FA-75:** If the brake pedal is pressed beyond a certain threshold value M, the braking force is strengthened to 100%.
2.3 Properties, Constraints and Interfaces

2.3.1 User Interface and Settings

2.3.1.1 Cruise control lever

FA-41: Figure: Cruise control lever with four directions of movement

FA-42: The cruise control lever is mounted on the steering wheel switch module.

2.3.1.2 Speed limiting lever

FA-44: Figure: Speed limiting lever integrated in the cruise control lever

FA-45: The enabling/disabling of the speed limit is done by pressing the head of the cruise control lever.

FA-46: Switching between cruise control and speed limit function is indicated by an LED integrated in the cruise control lever. Additionally, a haptic feedback is provided by engaging/disengaging the lever).

2.3.1.3 Brake Pedal

FA-48: The brake pedal is mounted in the footwell area of the driver

2.3.1.4 Gas pedal

FA-50: The gas pedal is mounted in the footwell area of the driver.

2.3.2 Functional safety

FA-52: The functions of the system are classified as safety relevant in with respect to ISO 26262.

FA-53: The safety classification of the system “speed control” is ASIL B.

3 Characteristics and boundary conditions

Arc-71: The systems are installed in left- and right-hand drive vehicles.
4 Interface

4.1 Overview E/E-Architecture

Figure: E/E-Architecture High-End-Stage
Figure: E/E-Architecture Compact Car

4.2 Parameters

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<th>Meaning</th>
<th>I-CAN</th>
<th>F-CAN</th>
<th>F-FLEX</th>
<th>LIN-Bus</th>
<th>Sender</th>
<th>Length</th>
<th>Min-Value</th>
<th>Max-Value</th>
<th>Enumeration/Encryption</th>
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<td>Clamp 15, i.e. status of ignition key</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>GW or EZS</td>
<td>5 Bit</td>
<td>0</td>
<td>31</td>
<td>0 – No key inserted</td>
<td>1 – Key inserted, 2 – Key in radio position, 3 – Key in ignition on position, 4 – Key in starting position, 5 .. 6 – not used, 7 – Error</td>
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<td>X</td>
<td></td>
<td></td>
<td>1 Bit</td>
<td>0</td>
<td>1</td>
<td>0 – No key inserted in lock 1 – Key is in the lock</td>
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<td>CONFIG_1</td>
<td>Vehicle configuration of driver position (left/right)</td>
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<td>X</td>
<td>GW or EZS</td>
<td>2 Bit</td>
<td>0</td>
<td>3</td>
<td>0 – Left hand drive, 1 – Right hand drive, 2 – not used, 3 – Error</td>
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<td>R_VehicleSpeed_kmh</td>
<td>Current vehicle speed</td>
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<td>X</td>
<td>X</td>
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<td>65535</td>
<td>Resolution: 0.1 km/h Value range: 0.0 km/h .. 6553.4 km/h</td>
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SyS-LH C34-223

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Department: SPES R&D
Date: 2013-08-01
Version: 004

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<td>R_LightSwitch__b</td>
<td>Status of light rotary switch</td>
<td>X</td>
<td>X</td>
<td>LDS</td>
<td>3 Bit</td>
<td>0</td>
<td>3</td>
<td>0 – Off 1 – Auto (Automatic position) 2 – Low beam light (LoBm) 3 – Left parking light (PkLmpLt) 4 – Right parking light (PkLmpRt) 5 – Position light (PosnLmp) 6 – not used 7 – Error</td>
<td></td>
<td></td>
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<td>R_exteriorBrightness_lx</td>
<td>Measurement of rain/light sensor regarding brightness</td>
<td>X</td>
<td>X</td>
<td>DBE</td>
<td>16 Bit</td>
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<td>Measurement of rain/light sensor regarding rainfall</td>
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<td>X</td>
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<td>2 Bit</td>
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<td>like LMP_STATUS_B_FL</td>
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</table>
| LMP_STATUS_HB_FL          | Lamp status high beam light front left           | X     |       |        | FLM     | 3 Bit  | 0         | 7          | 0 – Lamp OK
|                           |                                                  |       |       |        |         |        |           |           | 1 – Lamp defect
|                           |                                                  |       |       |        |         |        |           |           | 2 – Lamp motor defect
|                           |                                                  |       |       |        |         |        |           |           | 3 .. 6 – not used
|                           |                                                  |       |       |        |         |        |           |           | 7 – Error (e.g. implausible resistance value of the lamp)
| LMP_STATUS_HB.FR          | Lamp Status high beam light front right          | X     |       |        | FLM     |        |           |           | like LMP_STATUS_HB_FL  |
| P_LowBeam_b               | Low beam command                                 | X     |       |        |         | 1 Bit  | 0         | 1          | 0 – Low beam light off
|                           |                                                  |       |       |        |         |        |           |           | 1 – Low beam light on  |
| R_HighBeam_b              | High beam                                       | X     |       |        |         | 1 Bit  | 0         | 1          | 0 – Light off

**System Requirements Specification**

**SyS-LH C34-223**

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Keine Änderung ohne Genehmigung der federführenden Konstruktion /
Any alterations are subject to the approval of the design department

Author: Dr. Frank Houdek
Department: SPES R&D
Date: 2013-08-01
Version: 004
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<table>
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<th>Meaning</th>
<th>I-CAN</th>
<th>F-CAN</th>
<th>F-FLEX</th>
<th>LIN-Bus</th>
<th>Sender</th>
<th>Length</th>
<th>Min-Value</th>
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<td>P_HBRange_m High beam light range</td>
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<td>10 Bit</td>
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<td>1023</td>
<td>0 .. 300 – Desired light range 301 .. 1023 – Not used</td>
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<td>HB_MOT_CMD Desired position for high beam motor</td>
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<td>15</td>
<td>0 .. 15 Desired position regarding following table: 0 – 65m 1 – 100m 2 .. 14 – 120 .. 360m (20m step size) 15 – not used</td>
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<td>1 Bit</td>
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<td>1 Bit</td>
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<td>1 Bit</td>
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<td>1 Bit</td>
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<td>0 – Light off 1 – Light on</td>
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<td>7 Bit</td>
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<td>127</td>
<td>0 .. 100 – degree in percent 101 .. 127 – light off</td>
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<td>7 Bit</td>
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<td>127</td>
<td>0 .. 100 – degree in percent 101 .. 127 – light off</td>
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<td>7</td>
<td>0 – Neutral position 1 – Downward deflection of 5° recognized 2 - Downward deflection of 7° recognized 3 – Upward deflection of 5° recognized 4 – Upward deflection of 7° recognized 5 .. 6 – not used 7 – Error</td>
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<td>0 – Neutral position 1 – Backward deflection recognized 2 – Forward deflection</td>
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<tr>
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<td>I-CAN</td>
<td>F-CAN</td>
<td>F-FLEX</td>
<td>LIN-Bus</td>
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<td>1 .. 410 – steering wheel rotation to the left (Resolution: 1 ° starting from 10 ° deflection)</td>
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</table>
| DKT_STATUS | Status darkness switch (only armored vehicles)                         | X     |       |        |         | OBF    | 2 Bit  | 0         | 3         | 0 – Darkness switch not activated  
|            |                                                                         |       |       |        |         |        |        |           |           | 1 – Darkness switch activated  
|            |                                                                         |       |       |        |         |        |        |           |           | 2 – not used           
|            |                                                                         |       |       |        |         |        |        |           |           | 3 – Error             |
| BRK_STATUS | Deflection of the brake pedal from the neutral position                 | X     |       |        |         | ESP    | 8 Bit  | 0         | 255       | Resolution: 0,2°  
|            |                                                                         |       |       |        |         |        |        |           |           | Value range: 0 - 45° i.e. 0 - 225  
|            |                                                                         |       |       |        |         |        |        |           |           | 226 .. 254 – Not used  
|            |                                                                         |       |       |        |         |        |        |           |           | 255 – Error            |
| LRR_STATUS | Status of long-range radar sensors                                      | X     |       |        |         | RU     | 2 Bit  | 0         | 3         | 0 – Sensor calibrating  
|            |                                                                         |       |       |        |         |        |        |           |           | 1 – Sensor ready        
|            |                                                                         |       |       |        |         |        |        |           |           | 2 – Sensor is dirty     
|            |                                                                         |       |       |        |         |        |        |           |           | 3 – Sensor not ready    |
| LRR_DETECT | Evaluation of long-range radar sensor                                   | X     |       |        |         | RU     | 8 Bit  | 0         | 255       | 0 – No detected obstacle in the travel corridor  
|            |                                                                         |       |       |        |         |        |        |           |           | 1 .. 200 – Obstacle detected in the travel corridor; distance in meters  
|            |                                                                         |       |       |        |         |        |        |           |           | 201 .. 254 – not used  
|            |                                                                         |       |       |        |         |        |        |           |           | 255 – Error            |
| R_AdvVehicle_ b | Advancing vehicle detected                                               | X     |       |        |         |        | 1 Bit  | 0         | 1         | 0 – No advancing vehicle recognized  
|            |                                                                         |       |       |        |         |        |        |           |           | 1 – Advancing vehicle recognized |
| R_Locked_b | Status vehicle locking                                                  | X     |       |        |         |        | 1 Bit  | 0         | 1         | 0 – Vehicle unlocked      
|            |                                                                         |       |       |        |         |        |        |           |           | 1 – Vehicle locked       |
| VID_STATUS | Status of camera                                                        | X     |       |        |         | KU     | 2 Bit  | 0         | 3         | 0 – Sensor calibrating    
|            |                                                                         |       |       |        |         |        |        |           |           | 1 – Sensor ready         
|            |                                                                         |       |       |        |         |        |        |           |           | 2 – Sensor is dirty      
|            |                                                                         |       |       |        |         |        |        |           |           | 3 – Sensor not ready     |
| GAS_STATUS | Deflection of the gas pedal from the neutral position                   | X     |       |        |         | MSG    | 8 Bit  | 0         | 255       | Resolution: 0,2°  
|            |                                                                         |       |       |        |         |        |        |           |           | Value range: 0 - 45° i.e. 0 - 225  
|            |                                                                         |       |       |        |         |        |        |           |           | 226 .. 254 – Not used  
|            |                                                                         |       |       |        |         |        |        |           |           | 255 – Error            |
| N_MOT      | Revolution speed of motor                                               | X     | X     | X       |         | MSG    | 10 Bit | 0         | 1023      | 0 .. 1000 – Current revolution speed,  
|            |                                                                         |       |       |        |         |        |        |           |           | Resolution: 10 rev / min (i.e., 0 .. 10,000 rev / min)  
|            |                                                                         |       |       |        |         |        |        |           |           | 1001 .. 1022 – Not used  
<p>|            |                                                                         |       |       |        |         |        |        |           |           | 1023 – Error (measured value is not available) |
| ROT_FL     | Front left wheel                                                        | X     | X     | X       |         | ESP    | 16 Bit | 0         | 65534     | Resolution detents per |</p>
<table>
<thead>
<tr>
<th>Meanings</th>
<th>I-CAN</th>
<th>F-CAN</th>
<th>F-FLEX</th>
<th>LIN-Bus</th>
<th>Sender</th>
<th>Length</th>
<th>Min-Value</th>
<th>Max-Value</th>
<th>Enumeration/Encryption</th>
</tr>
</thead>
<tbody>
<tr>
<td>turning speed</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>R_DoorLeft_St Status of vehicle door left</td>
<td>X</td>
<td></td>
<td></td>
<td>TSG</td>
<td>4 Bit</td>
<td>0</td>
<td>15</td>
<td>A0 A1 A2 A3 with</td>
<td>A0 A1: front left door</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>A0, A1: front left door</td>
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<td></td>
<td></td>
<td></td>
<td>00 = door open,</td>
<td>01 = door closed,</td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td>10 = n.a.</td>
<td>11 = error</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>A2, A3: rear left door</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>00 = door open,</td>
<td>01 = door closed,</td>
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<td></td>
<td></td>
<td>10 = n.a.</td>
<td>11 = error</td>
</tr>
<tr>
<td>R_DoorRight_St Status of vehicle door right</td>
<td>X</td>
<td></td>
<td></td>
<td>TSG</td>
<td>4 Bit</td>
<td>0</td>
<td>15</td>
<td>A0 A1 A2 A3 with</td>
<td>A0, A1: front right door</td>
</tr>
<tr>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>A0, A1: front right door</td>
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<td></td>
<td>00 = door open,</td>
<td>01 = door closed,</td>
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<td></td>
<td></td>
<td>10 = n.a.</td>
<td>11 = error</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>A2, A3: rear right door</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>00 = door open,</td>
<td>01 = door closed,</td>
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<tr>
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<td></td>
<td></td>
<td>10 = n.a.</td>
<td>11 = error</td>
</tr>
<tr>
<td>R_Motor_b Status Motor</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>1 Bit</td>
<td>0</td>
<td>1</td>
<td>0 – Motor off</td>
<td>1 – Motor running (or error)</td>
</tr>
<tr>
<td>IC_CFG_1 Selected configuration in instrument cluster</td>
<td>X</td>
<td>X</td>
<td></td>
<td>KI</td>
<td>8 Bit</td>
<td>0</td>
<td>255</td>
<td>A0 A1 A2 .. A7 with</td>
<td>A0: 1 = Daytime running lights activated,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A0: 0 = Daytime running lights deactivated</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A1: 1 = Ambient lighting activated,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A1: 0 = Ambient lighting deactivated</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>A2 ..A7 – No meaning</td>
<td></td>
</tr>
<tr>
<td>R_TrafficSign Detected traffic signs (speed limit)</td>
<td>X</td>
<td>X</td>
<td></td>
<td>KU</td>
<td>8 Bit</td>
<td>0</td>
<td>255</td>
<td>A0, A1, A2, A3 ... A7 with</td>
<td>A0: 0 = valid Signal,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A0: 1 = error</td>
<td>A1: 0 = Sign without addition,</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A1: 1 = Sign with addition</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A2:</td>
<td></td>
</tr>
</tbody>
</table>

**Meanings**
- Turning speed
- Status of vehicle door left
- Status of vehicle door right
- Status Motor
- Selected configuration in instrument cluster
- Detected traffic signs (speed limit)
### Constants

<table>
<thead>
<tr>
<th>Name</th>
<th>Identifier</th>
<th>Meaning</th>
<th>Function</th>
<th>Min-Value</th>
<th>Max-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TH_ExtBrightness_1</td>
<td>S1</td>
<td>If the threshold is underrun, the low beam is activated.</td>
<td>Low beam</td>
<td>0</td>
<td>65535</td>
</tr>
<tr>
<td>TH_ExtBrightness_2</td>
<td>S2</td>
<td>If the threshold is overrun, the low beam is deactivated.</td>
<td>Low beam</td>
<td>0</td>
<td>65535</td>
</tr>
<tr>
<td>TH_Acoustic_Warn</td>
<td>t</td>
<td>Correction factor for distance calculation (time) to the vehicle in front with audio warning</td>
<td>Distance warning</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>TH_Optical_Warn</td>
<td>t2</td>
<td>Correction factor for distance calculation (time) to the vehicle in front with optical warning</td>
<td>Distance warning</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Deceleration_Max</td>
<td>aneg</td>
<td>Maximum negative deceleration of the vehicle</td>
<td>Emergency Brake Assist</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Crash_1</td>
<td>ta</td>
<td>Threshold for activating the emergency brake with audible warning and deceleration x%</td>
<td>Emergency Brake Assist</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Crash_2</td>
<td>ta2</td>
<td>Threshold for activation of the emergency braking during deceleration y%</td>
<td>Emergency Brake Assist</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>BrakeActivation_1</td>
<td>x</td>
<td>Brake emergency activation level 1</td>
<td>Emergency Brake Assist</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>BrakeActivation_2</td>
<td>y</td>
<td>Brake emergency activation level 2</td>
<td>Emergency Brake Assist</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Stepsize_CruiseControl</td>
<td>N</td>
<td>Step size for setting the cruise control</td>
<td>Cruise control</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Delay_Autorepeat</td>
<td>t</td>
<td>Time interval, after that the cruise control set point is automatically increased or reduced when holding the cruise control lever.</td>
<td>Cruise control</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Stepsize_SpeedControl</td>
<td>N</td>
<td>Step size for setting the speed control</td>
<td>Speed restriction</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>TH_BrakingPedal</td>
<td>M</td>
<td>If the threshold is overrun, the brake assist system gets active</td>
<td>Brake assist</td>
<td>0</td>
<td>255</td>
</tr>
</tbody>
</table>

0 = No sign detected, 1 = Sign detected
A3...A7: Detected speed value with the following code
0=20, 1=30, 2=40, ...., 11=130, 12...31= No meaning

### 4.3 Constants