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Requirements Specification
FRS AUS4 Camera

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1 General

1.1 Version history

Version	Author	Content		Date
1.0	Adeliina Aho Tarkka	First version		2012-04-11
2.0	Christer Aspman	**General**		2013-09-23
		Added version handling on requirements		
		Updated requirements	**New version**	
		UFR 523_Camera view_11	2	
		UFR 523_Camera view_14	2	
		UFR 523_Camera view_18	2	
		Deleted requirements		
		UFR 523_Camera view_20		
		UFR 523_Camera view_21		
		UFR 523_Camera view_22		
		New requirements		
		UFR 523_Camera view_23 to UFR 523_Camera view_58		
(3.0) 0	Christer Aspman	**General**		2013-02-01
		Added parameters and CAN signals. Broken down requirements from UFR. Merged with AER document. Changed to FRS specification template Changed requirement ID prefix from UFR 523_Camera view_ to FRS523_ e g UFR 523_Camera view_58 is now identified as FRS523_58 New version (0) due to new document template.		
		Updated requirements	**New version**	
		Deleted requirements		
		78		
		New requirements		
		FRS523_59 to FRS523_112		
1	Christer Aspman	**General**		2013-12-19
		Updated references		
		Updated abbreviations		
		Updated requirements	**New version**	
		FRS523_14	3	
		FRS523_16	2	
		FRS523_109	2	
		FRS523_74	2	
		FRS523_87	2	
		FRS523_16	2	
		Deleted requirements		

		AUS4_RFQ_1	
		AUS4_RFQ_2	
		AUS4_RFQ_3	
		AUS4_RFQ_4	
		AUS4_RFQ_5	
		AUS4_RFQ_6	
		AUS4_RFQ_7	
		AUS4_RFQ_8	
		FRS523_59	
		FRS523_72	
		FRS523_107	
		FRS523_108	
		FRS523_89	
		FRS523_27	
		FRS523_10	
		FRS523_74	
		FRS523_24	
		FRS523_36	
		FRS523_59	
		FRS523_38	
		FRS523_72	
		FRS523_73	
		FRS523_46	
		FRS523_86	
		FRS523_95	
		FRS523_96	
		New requirements	
		FRS523_113 to FRS523_128	

1.2 Purpose

The purpose with this document is to list the functionality for the new infotainment system, which will be possible to implement in both trucks and coaches. This document describes the camera functionality. The functionality is still to be finalized.

1.3 Background

When driving a heavy vehicle it can sometime be difficult for the driver to have a good overview around the vehicle. In these situations a camera can be a great help and show areas that the driver otherwise would not have seen.

With a camera solution connected to the vehicle the driver can receive additional information to what can be seen via the mirrors. The camera solution will enable the driver to see areas around the vehicle that are difficult to see from the driver's seat, and can therefore detect and avoid hazardous situations. The cameras can also be used for monitoring body-builder functionality and loads.

1.4 General description of the function

A camera view shall be shown in the display of the infotainment system. The video image shall be provided via an available video input. The video source can be a directly connected camera or a camera ECU. It shall not be necessary to specify the purpose of the video input, i.e. it can be a reverse view camera, a front camera, etc. EOL parameters will define the purpose of each video input on each unique vehicle.

The driver shall be able activate the camera view via the infotainment system, but it shall also be possible to activate the camera view via a pin. When the camera view is active other functionality in the system, e.g. sound, shall not be affected.

Please note, the camera functionality shall not replace the rear view mirrors, but shall be possible to replace the front mirrors and side view mirrors.

1.5 Abbreviations

AUS	Audio System
CAN	Controller Area Network
HMI	Human Machine Interface

1.6 References

1. 2126748 SRS Audio system
2. 2282481 CAN COMMUNICATION SPECIFICATION - Audio System AUS4
3. ISO/DIS 16505 Road Vehicles - Ergonomic and performance aspects of Camera Monitoring Systems - Requirements and test procedures .
4. 2003/97/EG DIRECTIVE 2003/97/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 10 November 2003
5. Diagnostics specification

2 Inputs/Outputs

2.1 Parameters

Type	Name	Range	Unit
EOL	Function_FrontCameraUpperSpeedLimit	0 - 250	km/h
EOL	Function_FrontCameraUpperSpeedHysteresis	0 - 250	km/h
EOL	Function_Camera1ReverseGeneralForwardDeactivationSpeed	0 - 250	km/h
EOL	Function_Camera2ReverseGeneralForwardDeactivationSpeed	0 - 250	km/h
EOL	Function_Camera1ReverseGeneralForwardHysteresis	0 - 250	km/h
EOL	Function_Camera2ReverseGeneralForwardHysteresis	0 - 250	km/h
EOL	Function_Camera1StartupTime	0 = off 1-10000	ms
EOL	Function_Camera2StartupTime	0 = off 1-10000	ms
EOL	Function_Camera1	Off GeneralCam Reverse FrontView	
EOL	Function_Camera2	Off GeneralCam Reverse FrontView	

Type	Name	Range	Unit
EOL	ReverseGuidelinesCamera1	Off Image 1 To Image 10	
EOL	ReverseGuidelinesCamera2	Off Image 1 To Image 10	
EOL	Function_GeneralCameraActivationWorklightCamera1	Off On	
EOL	Function_GeneralCameraActivationWorklightCamera2	Off On	
EOL	Function_GeneralCameraActivationDirectionIndicatorsCamera1	Off On	
EOL	Function_GeneralCameraActivationDirectionIndicatorsCamera2	Off On	

2.2 Sensors and actuators

Type	Number	Name	Range	Unit	Description/Comment
Analogue in		Camera1Activate	0-12	V	See HW spec.
Analogue in		Camera2Activate	0-12	V	See HW spec.
Analouge out		Camera 1 wake-up	0-12	V	See HW spec.
Analouge out		Camera 2 wake-up	0-12	V	See HW spec.
Analouge in		Camera 1		CVBS (PAL and NTSC)	
Analoguge in		Camera 2		CVBS (PAL and NTSC)	

2.3 CAN-signals

2.3.1 Messages

The needed CAN messages are described shortly below. The content of each message is described with its signals. Some signals are described separately. Please note that the purpose of this chapter is only to give a better understanding, this is not a complete description of the CAN-protocol. For complete information see CAN Specification.

Direction	Message	Signals
Received	ETC5	TransReverseDirectionSwitch
Received	TCO1	Tachograph Vehicle Speed (TCOVehSpeed)
Sent	RadioConfiguration	VideoSource1Available VideoSource2Available
Sent	RadioInformation	VideoSource1Connected VideoSource2Connected
Received	RadioControl	VideoSource1Request VideoSource2Request
Sent	Video Configuration	VideoSource1Function VideoSource2Function

		VideoSource1DirectionIndicatorActivation VideoSource1WorkLightActivation VideoSource2DirectionIndicatorActivation VideoSource2WorkLightActivation
Received	CUVInformation	Direction Indicator Lever Status Worklight Toggle Switch

3 Function requirements

2 Camera inputs shall be available. OSD (On Screen Display) shall be possible, e.g. to show help lines, distance marks or menu items on the camera image. The camera image shall never freeze since the system may be safety critical. The hardware shall therefore be designed to minimize freezes and delays, for example the video image shall not be affected by the system software. The system shall support both the PAL and NTSC video format. The system needs to automatically detect the format used and make necessary adjustments to be able to show the camera image without any user interaction.

3.1 General

Req-ID	ver	Requirement
FRS523_110	1	The camera function shall be available in performance step "Standard".
FRS523_9	1	The camera image shall be shown on the display of the system. The image shall be provided via a video input. The video source can be a directly connected camera or via a camera ECU.
FRS523_11	2	It shall be possible to activate and deactivate the camera manually via hard-keys.
FRS523_12	1	It shall be possible to activate and deactivate the camera automatically, e.g. via a reverse signal. Activation and deactivation shall also be possible via a speed signal. Signal for activation and deactivation shall be received from CAN. Since the use for each input is unknown the conditions must be configurable by EOL coding.
FRS523_13	1	When the infotainment system has received an activation or deactivation signal, it shall send an activation or deactivation request to the connected camera.
FRS523_14	3	If no camera is detected and a switching to camera is initiated by another system, via CAN, or by the user, the system shall ignore this command. A notification shall be presented to the user that no camera is connected.
FRS523_15	1	If the activation takes a long time, feedback shall be given to the driver as an indication that an activation is ongoing.
FRS523_16	2	When the camera view is deactivated, the system shall transit to the latest used view other than the camera view, or the view for the active source, in case the source where changed during the camera was active. If the system was turned on in camera view, the system shall shift to the last state, e g • On, with last used source, or • Standby See reference 1. SRS for power-states.
FRS523_17	1	If no camera is connected to the system, this shall be clearly communicated to the driver if the system is expecting a camera due to configuration.
FRS523_18	2	The camera image shall not be frozen or delayed. However, if the camera image is frozen or delayed, due to a fault, this shall be clearly

		communicated to the driver.
FRS523_19	1	If a camera is not available, information shall be sent to the system and shall be clearly shown on the display.
FRS523_23	1	The infotainment system shall be equipped with a 12V Camera ON output signal to wake up a connected camera when the system enters the camera view. There shall be one for each camera input.
FRS523_25	1	The infotainment system shall show input from a connected camera with maximum 50 ms delay.
FRS523_53	1	The start-up time on the system, from Sate = Off until a camera-image is showing on the display shall be no more than 2s. See Ref 1. SRS for ECU states.
FRS523_54	1	When the infotainment-system is running and a camera-view is commanded on CAN there shall be no more than 500 ms latency in the Infotainment system until the image is showing on the display. Please note that this requirement assumes a camera image is already available, any camera-delay is not covered.
FRS523_26	1	A general purpose camera interface is needed that supports most camera systems on the aftermarket. See reference 1. SRS for more information.
FRS523_29	1	In the HMI it shall be possible to enable and disable the automatic camera activation when reversing, if the camera is configured as a reverse camera.
FRS523_30	1	It shall be possible to toggle between the available camera inputs via a hard key on the face-plate.
FRS523_31	1	It shall be possible to activate each of the available camera inputs via CAN.
FRS523_32	2	It shall be possible to deactivate each of the available camera inputs via CAN. This is only valid if the camera was activated via CAN. In this case the view shall be replaced with the view displayed before transiting to the camera view or the view for currently active source.
FRS523_33	1	It shall be possible to set an upper speed limit for each video input by parameterization at EOL and aftermarket. If the vehicle speed exceeds the speed limit the infotainment system shall deactivate the camera view.
FRS523_34	1	The system shall listen on the parking brake active signal and speed signal on CAN to determine if the vehicle is moving or not.
FRS523_35	1	The system shall listen on the speed signal on CAN to determine the vehicle speed and the reverse signal to make sure the vehicle is heading forwards.
FRS523_37	2	It shall be possible to choose by EOL and after-market programming (diagnostics) what purpose a video input has (front view, reverse view, other). I e this shall be possible to change during the lifetime of the product.
FRS523_39	2	Information sent on CAN, regarding other functions in the infotainment system, shall not be affected by the camera function (radio information and navigation information

		shall still be accessible in the instrument cluster)
FRS523_40	1	It shall be possible to use the steering wheel buttons or other hard keys to change audio source, radio station, track, volume etc. during camera image.
FRS523_60	1	The camera image shall not flicker when the infotainment system is changing between states.
FRS523_61	1	The camera function shall not affect the audio playback of the infotainment system. It shall be possible to play sound in the loudspeakers and change between and control (play, mute, skip forward/backward, fast forward/backward, …) audio sources (Radio, CD, AUX, …), by user input on the infotainment systems display and via CAN.
FRS523_62	1	It shall be possible to activate the camera view and show a camera image on the infotainment systems display by activating the activation-pins for each camera. I e: If: - **Camera1Activate** is high Show the picture from camera 1 If: - **Camera2Activate** is high Show the picture from camera 2
FRS523_111	1	The activation of cameras via the activation-pins **Camera1Activate** and **Camera2Activate** overrides the speed-limitations on displaying camera.
FRS523_113		The activation of cameras via CAN in separate message **RadioControl** overrides the speed-limitations on displaying camera.
FRS523_63	1	The infotainment system shall be equipped with a camera activation hard key in the front fascia. If pressing the hard key the infotainment system shall switch to the camera view.
FRS523_64	1	If the infotainment system is equipped with two camera inputs and one hard key the hard key shall be configurable to show: - camera input 1 - camera input 2 - toggle between camera input 1 and camera input 2 when pressing the button. The user shall be able to configure the hard key in a separate menu in the HMI of the infotainment system. Note: The default configuration shall be to toggle between the two inputs and the main-view.
FRS523_65	1	If the infotainment system has more than one camera connected and more than one

		of the cameras has a valid and active signal that requests for the camera view it shall be possible to toggle between the cameras by pressing the camera button. Note: This requirement is not valid if one camera is configured as front camera. See prioritization table in requirement FRS523_104.
FRS523_66	1	The camera wake-up signal (see FRS523_23) shall go active without any delay when a camera view activation event is received.
FRS523_67	1	The camera wake-up signal (see FRS523_23) shall be active high before the camera view is enabled.
FRS523_68	1	The camera input shall provide a stable image before the camera view is enabled. If no stable image is available but conditions to enable the camera view is fulfilled the function shall continue to search for a stable image from the camera and enable the camera view as soon as an image is available.
FRS523_69	1	Each camera input shall be able to detect whether or not a camera is connected to the system.
FRS523_70	1	For each input configured in parameters Function_Camera1 and Function_Camera2 the infotainment system shall search for a connected camera at startup of the system.
FRS523_71	1	Each camera input shall be able to detect if a valid camera image is sent on the camera input.
FRS523_75	1	The different methods to activate the camera view for each camera shall have different priorities.
FRS523_98	1	Camera 1 shall only be enabled if parameter **Function_Camera1** is not set to **off**. Camera 2 shall only be enabled if parameter **Function_Camera2** is not set to **off**.
FRS523_99	1	Camera 1 functionality shall be defined by parameter **Function_Camera1**. Camera 2 functionality shall be defined by parameter **Function_Camera2**.
FRS523_100	1	If a time is specified in parameter **Function_Camera1StartupTime** a predefined image shall be displayed while activating camera 1. The image shall be displayed as soon as the decision to start the camera is made and during the specified time. This is to allow the camera hardware a start-up latency and provide the user with information while the camera is starting. The same applies for camera 2 in parameter **Function_Camera2StartupTime.**
FRS523_101	1	In general a configured front camera has higher prio than Reverse camera and GeneralCam camera. Requirement FRS523_104 clarifies this.
FRS523_102	1	In general a configured reverse camera has higher prio than a GeneralCam camera. Requirement FRS523_104 clarifies this.
FRS523_103	1	In general if both camera inputs are equally configured input 1 has higher prio than input 2. Requirement FRS523_104 clarifies this.

<table>
<tr><td>FRS523_112</td><td>1</td><td>If several conditions are fulfilled that activates a camera, the camera shall remain activated until all conditions that deactivates the camera are fulfilled. E g an automatic activation due to speed in parallel with a separate CAN-request shall keep the camera active until a CAN-request for deactivation is received.</td></tr>
<tr><td>FRS523_104</td><td>1</td><td>If conditions for both camera inputs are fulfilled simultaneously the prioritization shall follow the table below. Configuration according to parameters Function_Camera1 and Function_Camera2. Conditions in this case can be hard pin, CAN-requests and other CAN-signals (speed-signals, brake-signals, gear).
<table>
<tr><th>Function_Camera1</th><th>Function_Camera2</th><th>Prioritized input</th></tr>
<tr><td>Off</td><td>Off</td><td>n/a</td></tr>
<tr><td>Off</td><td>GeneralCam</td><td>2</td></tr>
<tr><td>Off</td><td>Reverse</td><td>2</td></tr>
<tr><td>Off</td><td>Front</td><td>2</td></tr>
<tr><td>GeneralCam</td><td>Off</td><td>1</td></tr>
<tr><td>GeneralCam</td><td>GeneralCam</td><td>Initially 1 but possible to toggle with HMI</td></tr>
<tr><td>GeneralCam</td><td>Reverse</td><td>Initially 2 but possible to toggle with HMI</td></tr>
<tr><td>GeneralCam</td><td>Front</td><td>2</td></tr>
<tr><td>Reverse</td><td>Off</td><td>1</td></tr>
<tr><td>Reverse</td><td>GeneralCam</td><td>Initially 1 but possible to toggle with HMI</td></tr>
<tr><td>Reverse</td><td>Reverse</td><td>Initially 1 but possible to toggle with HMI</td></tr>
<tr><td>Reverse</td><td>Front</td><td>2</td></tr>
<tr><td>Front</td><td>Off</td><td>1</td></tr>
<tr><td>Front</td><td>GeneralCam</td><td>1</td></tr>
<tr><td>Front</td><td>Reverse</td><td>1</td></tr>
<tr><td>Front</td><td>Front</td><td>1</td></tr>
</table>
</td></tr>
<tr><td>FRS523_114</td><td>1</td><td>It shall be possible to activate the camera inputs based on direction indicators and work light activation.</td></tr>
</table>

3.2 CAN Communication requirements

Req-ID	ver	Requirement
FRS523_94	1	Camera status shall continuously be sent in the message Video Configuration.
FRS523_115	1	**Video Configuration.VideoSource1Function** shall be set as follows: • **Video source disabled.** If camera-image not is showing on screen. • **General camera.** If camera-image from input 1 is showing on screen and input 1 is configured as a general camera. • **RearView.** If camera-image from input 1 is showing on screen and input 1 is configured as rear view camera. • **FrontView**. If camera-image from input 1 is showing on screen and input 1 is configured as rear view camera. • **DontCare.** If none of the above above applies.
FRS523_116	1	**Video Configuration.VideoSource2Function** shall be set as follows: • **Video source disabled.** If camera-image not is showing on screen. • **General camera.** If camera-image from input 2 is showing on screen and input 2 is configured as a general camera. • **RearView.** If camera-image from input 2 is showing on screen and input 2 is configured as rear view camera. • **FrontView**. If camera-image from input 2 is showing on screen and input 2 is configured as rear view camera. • **DontCare.** If none of the above above applies.
FRS523_117	1	**VideoConfiguration. VideoSource1DirectionIndicatorActivation** shall be set to • ActivatedByDirectionIndicator if the video input 1 is activated by the direction indicator. • NotActivatedByDirectionIndicator if the video input 1 is not activated by the direction indicator but is configured so it could be. • Dont care, in all other cases.
FRS523_118	1	**VideoConfiguration. VideoSource2DirectionIndicatorActivation** shall be set to • ActivatedByDirectionIndicator if the video input 2 is activated by the direction indicator. • NotActivatedByDirectionIndicator if the video input 2 is not activated by the direction indicator but is configured so it could be. • Dont care, in all other cases.
FRS523_119	1	**VideoConfiguration. VideoSource1WorkLightActivation** shall be set to • ActivatedByWorkLight if the video input 1 is activated by work light. • NotActivatedByWorkLight if the video input 1 is not activated by the work-light but is configured so it could be. • Dont care, in all other cases.
FRS523_120	1	**VideoConfiguration. VideoSource2WorkLightActivation** shall be set to • ActivatedByWorkLight if the video input 2 is activated by work light. • NotActivatedByWorkLight if the video input 2 is not activated by the work-light but is configured so it could be. • Dont care, in all other cases.

FRS523_109	2	It shall be possible to activate the camera view and show a camera image on the infotainment systems display by CAN. If: - **RadioControl.VideoSource1Request** = VideoSource1Requested Show the picture from camera 1 Else If: - **RadioControl.VideoSource2Request** = VideoSource2Requested Show the picture from camera 2. If both are requested the prioritization table in requirement FRS523_104 applies.
FRS523_121	1	Configuration status of Camera 1 shall be transmitted by CAN message. If the infotainment system is not equipped with Camera 1 or the Camera 1 function is disabled, transmit: **RadioConfiguration.VideoSource1_Available** = No VideoSource1 available If the infotainment system is equipped with Camera 1 input, transmit: **RadioConfiguration.VideoSource1_Available** = VideoSource1 source available The signal shall be sent even if no camera is connected to the infotainment system. If no information about the camera configuration status is available during start-up, transmit: **RadioConfiguration.VideoSource1_Available** = Don't care
FRS523_122	1	Configuration status of Camera 2 shall be transmitted by CAN message. If the infotainment system is not equipped with Camera 2 or the Camera 2 function is disabled, transmit: **RadioConfiguration.VideoSource2_Available** = No VideoSource2 available If the infotainment system is equipped with Camera 2 input, transmit: **RadioConfiguration.VideoSource2_Available** = VideoSource2 source available The signal shall be sent even if no camera is connected to the infotainment system. If no information about the camera configuration status is available during start-up, transmit: **RadioConfiguration.VideoSource2_Available** = Don't care

FRS523_123	1	Camera 1 status input shall be transmitted on CAN. The camera 1 is considered connected if a video source is connected to the infotainment systems camera 1 input. **RadioInformation.VideoSource1Connected** = No VideoSource1Connected **RadioInformation.VideoSource1Connected** = VideoSource1Connected
FRS523_124	1	Camera 2 status input shall be transmitted on CAN. The camera 2 is considered connected if a video source is connected to the infotainment systems camera 1 input. **RadioInformation.VideoSource2Connected** = No VideoSource2Connected **RadioInformation.VideoSource2Connected** = VideoSource2Connected
FRS523_125	1	If parameter **Function_GeneralCameraActivationWorklightCamera1** is set to on the camera 1 input shall be activated when signal **CUVInformation.WorklightToggleSwitch** = On.
FRS523_126	1	If parameter **Function_GeneralCameraActivationWorklightCamera2** is set to on the camera 2 input shall be activated when signal **CUVInformation.WorklightToggleSwitch** = On.
FRS523_127	1	For a vehicle with the driver position on the left side: If parameter **Function_GeneralCameraActivationDirectionIndicatorsCamera1** is set to on the camera 1 input shall be activated when **CUVInformation. Direction Indicator Lever Status** = Direction indicator left activated. For a vehicle with the driver position on the right side: If parameter **Function_GeneralCameraActivationDirectionIndicatorsCamera1** is set to on the camera 1 input shall be activated when **CUVInformation. Direction Indicator Lever Status** = Direction indicator right activated. Parameter to decide the steering position will be defined later.

FRS523_128	1	For a vehicle with the driver position on the left side: If parameter **Function_GeneralCameraActivationDirectionIndicatorsCamera2** is set to on the camera 2 input shall be activated when **CUVInformation. Direction Indicator Lever Status** = Direction indicator left activated. For a vehicle with the driver position on the right side: If parameter **Function_GeneralCameraActivationDirectionIndicatorsCamera2** is set to on the camera 2 input shall be activated when **CUVInformation. Direction Indicator Lever Status** = Direction indicator right activated. Parameter to decide the steering position will be defined later.

3.3 Front camera

3.3.1 Background

Legislation requires the driver to have clear sight around the front corner of the passenger side of the truck. Usually this requirement is met by mounting a mirror above the windscreen on the passenger side but other solutions are allowed. An alternative solution is to use a camera, mounted above the windscreen, instead of the mirror and use a display in the instrument panel to show the camera image. This solution is regulated in directive 2003/97/EG. According to the directive the display used to show the front camera image must be dedicated to show the front camera image when the vehicle is moving with a speed below 30 km/h. Over this speed the front camera image may be turned off and the display may be used to show other information, for example navigation or radio information.

3.3.2 General Requirements

Req-ID	ver	Requirement
FRS523_28	1	The video input shall act as a front camera if this is configured during EOL coding.
FRS523_41	1	The system shall comply with directive 2003/97/EG.
FRS523_57	1	The system shall comply with relevant parts of ISO standard ISO/DIS 16505. Since the standard is not yet finalized this will be discussed during development, but relevant parts is at least **display reflections** and **start-up time**. Relevant use-cases could e g be • **Direct light in the display** • **Cold Start**
FRS523_55	1	The system shall comply with new directives that affect camera-systems for commercial vehicles. The supplier shall discuss with Scania about possible new requirements that need to be considered.
FRS523_42	1	The front camera view shall work without any other camera systems connected to the system.
FRS523_56	1	When conditions are fulfilled and the front camera view is showing it shall not be possible to replace the camera view in the display, not by the HMI or via CAN.
FRS523_43	1	It shall be possible to have both a reverse view and a front view camera connected to the system simultaneously, e.g. reverse camera connected to Video_in_1 and front camera connected to video_in_2 or vice versa.
FRS523_44	1	It shall be possible to set the upper speed limit (the point where the front camera image shall be turned off) by two parameters, defining a span, to have a hysteresis. This is to avoid flickering in the display when driving with a speed close or around the upper speed limit. It shall be possible to set these both in EOL coding and with aftermarket tools.
FRS523_45	1	No other image than the front-camera image shall be shown on the display when the vehicle is moving within the set speed range.
FRS523_47	1	When the vehicle speed is above the set speed range (the speed set by the leaving speed range parameter in previous requirement) the system shall deactivate camera view. See also requirement FRS523_16.

FRS523_48	1	It shall be possible to activate/deactivate the whole front camera function with EOL and aftermarket tools.
FRS523_49	1	It shall be possible to active/deactivate the function to automatically turn on/off the image when entering the speed interval with EOL and aftermarket tools.
FRS523_58	1	The front-camera shall be deactivated when the parking-brake is activated or the speed-signal is < 0. See also requirement FRS523_16.
FRS523_79	1	In front view the user shall not be able to change between views or states below a certain speed.
FRS523_80	1	If the vehicle is starting to move forward and the infotainment system is in another view than the camera view the infotainment system shall instantly switch to the front view.
FRS523_81	1	If the vehicle is starting to move forward and the infotainment system is in a state not able to display the camera image the infotainment system shall switch to the first state available that can fulfill the front view camera functionality requirements.

3.3.3 CAN communication requirements

Req-ID	ver	Requirement
FRS523_105	1	If the camera (1 or 2) is set to **FrontView** by parameter **Function_Camera1** or **Function_Camera2** the infotainment system shall enable and disable the camera input depending on speed forward according to requirements FRS523_83 and FRS523_82.
FRS523_83	1	The activation speed is defined by parameter **Function_FrontCameraUpperSpeedLimit** If - **Tachograph (TCO1).Tachograph Vehicle Speed (TCOVehSpeed)** > 0 and - **ETC1.TransReverseDirectionSwitch.TransReverseDirectionSwitch (ReverseSwitch)** = Off and • **CruiseControlVehSpeed. ParkingBrakeSwitch** = **ParkingBrakeNotSet** and - **Tachograph (TCO1).Tachograph Vehicle Speed (TCOVehSpeed) =< Function_FrontCameraUpperSpeedLimit** show the camera view.

FRS523_82	1	If the vehicle speed is above a certain speed the infotainment system shall switch to the view displayed before the camera view was enabled. The deactivation speed is decided by parameter: **Function_FrontCameraUpperSpeedLimit** and a hysteresis parameter **Function_FrontCameraUpperSpeedHysteresis** If front camera view is enabled and **Tachograph (TCO1).Tachograph Vehicle Speed (TCOVehSpeed)** > **Function_FrontCameraUpperSpeedLimit** + **Function_FrontCameraUpperSpeedHysteresis** the front camera view shall be disabled.

3.4 Reverse camera

3.4.1 Background

With a camera input configured as a reverse camera (at EOL coding and aftermarket) it is possible to see help lines on the display when reversing. The help lines are used to aid the driver to the correct place when parking and to draw the help lines correctly on the display they need to be adapted to the vehicles specification, on trucks this is especially important since each truck is configured and built for a special purpose. For the camera system the help lines are stored as static images in the infotainment system.

3.4.2 General requirements

Req-ID	ver	Requirement
FRS523_50	1	The static help lines images shall be adapted to the specific vehicle configuration. At least 10 images shall be stored in the system and used for different vehicle configurations. The images will be delivered during development. If the reverse camera is connected as camera 1 the reverse guidelines shall be selected by parameter **ReverseGuidelinesCamera1**. If the reverse camera is connected as camera 2 the reverse guidelines shall be selected by parameter **ReverseGuidelinesCamera2**. Please note that one option in the parameters is to have the reverse guidelines completely off.
FRS523_51	1	It shall be possible to activate and deactivate the help lines functionality by parameterization, both at EOL-programming and on the aftermarket. If a camera input is parameterized as reverse camera the help lines functionality shall be enabled.
FRS523_52	1	If the help lines function is enabled by parameterization, it shall be possible to toggle on/off the function in the HMI by the user.
FRS523_84	1	If parameter **Function_Camera[1, 2]** = Reverse. The camera shall work as a reverse camera.
FRS523_87	2	Camera view manually deactivated It shall be possible for the driver to manually deactivate (over ride) the camera view. See also requirement FRS523_16 for deactivation.
FRS523_88	1	Reverse help lines If the camera input in configured as a reverse camera the infotainment system shall be able to show reverse help guidelines in the display on top of the camera image.

3.4.3 CAN communication requirements

Req-ID	ver	Requirement
FRS523_90	1	The camera view shall be automatically activated when an indication that the truck will start reversing is sent to the infotainment system via CAN. If: - **TransReverseDirectionSwitch. TransForwardDirectionSwitch (NeutralSwitch)** = On and - **Tachograph (TCO1).Tachograph Vehicle Speed (TCOVehSpeed)** **=<** 1 km/h Or - **TransReverseDirectionSwitch. TransForwardDirectionSwitch (ReverseSwitch)** = On The camera view shall be activated for the camera used as reverse camera.
FRS523_91	1	The camera view shall be automatically deactivated after a certain speed forward. If **TransReverseDirectionSwitch. TransForwardDirectionSwitch (ForwardSwitch) = On** and **Tachograph (TCO1).Tachograph Vehicle Speed (TCOVehSpeed)** >**Function_Camera[1, 2]ReverseGeneralForwardDeactivationSpeed** + **Function_Camera[1, 2]ReverseGeneralForwardHysteresis** deactivate camera view. See also requirement FRS523_16 for deactivation.

3.5 GeneralCam camera functionality

3.5.1 Background

3.5.2 General requirements

Req-ID	ver	Requirement
FRS523_93	1	If parameter Camera[1-2]Functionality = GeneralCam The camera shall work as GeneralCam camera.
FRS523_97	1	It shall be possible for the driver to manually deactivate (over ride) the camera view and transit to the last view before the camera view was activated or transit to any view by pressing the camera hard key on the infotainment system for activating a view.

3.5.3 CAN communication requirements

Req-ID	ver	Requirement
FRS523_106	1	The camera view shall be automatically deactivated after a certain speed forward. If **TransReverseDirectionSwitch. TransForwardDirectionSwitch (ForwardSwitch)** = On and **Tachograph (TCO1).Tachograph Vehicle Speed (TCOVehSpeed)** > **Function_Camera[1, 2]ReverseGeneralForwardDeactivationSpeed** + **Function_Camera[1, 2]ReverseGeneralForwardHysteresis** deactivate the camera view. See also requirement FRS523_16 for deactivation.

4 Risk analysis

4.1 Identified risks with the function

Function	General failure mode	Interpretation	Vehicle effect	Severity	Preferred fail-state
	Picture freezes and the user is not notified.				
	Picture is lost while driving and using the camera as visual guidance.				
	Picture from camera is visible outside allowed speed-range.				
	Picture is never activated.				
	Picture has poor quality. Could be due to both failures in the system and due to external parameters such as sunlight.				

The camera function can be a great aid for the driver. However, it is important to have in mind that the use of the camera function has its risks and it is important to be aware of these.

The worst case would be if the displayed video image is incorrect. This could mean that inaccurate information is shown to the driver. Absent or unwanted functionality can be classified as equally severe and different users will react different to these two cases.

All functions are controlled by software and there is no spontaneous error causing the function breaking down. software failures are due to bugs in the software and shall thereby be handled in the design so that no hazardous situations occur. Another reason for function break down could be failure of hardware, for example bad conduct in the connectors. To prevent this hardware testing is necessary.

There are things that can break down and thereby inhibit the function to work as intended. The audio system itself can break down, the video input connecting the camera/camera system to the audio system, and the camera/camera system can also break down. This will lead to an incorrect video image or a freezing of the video image, and will cause a hazardous situation.

Below the possible hazards of the function are listed, divided in sub functions.
Omission = no functionality and commission = wrong functionality. Severity is set after how high the risk is for accident or VOR (vehicle off road). Higher risk means higher preferred fail-state since this is the most severe error.