

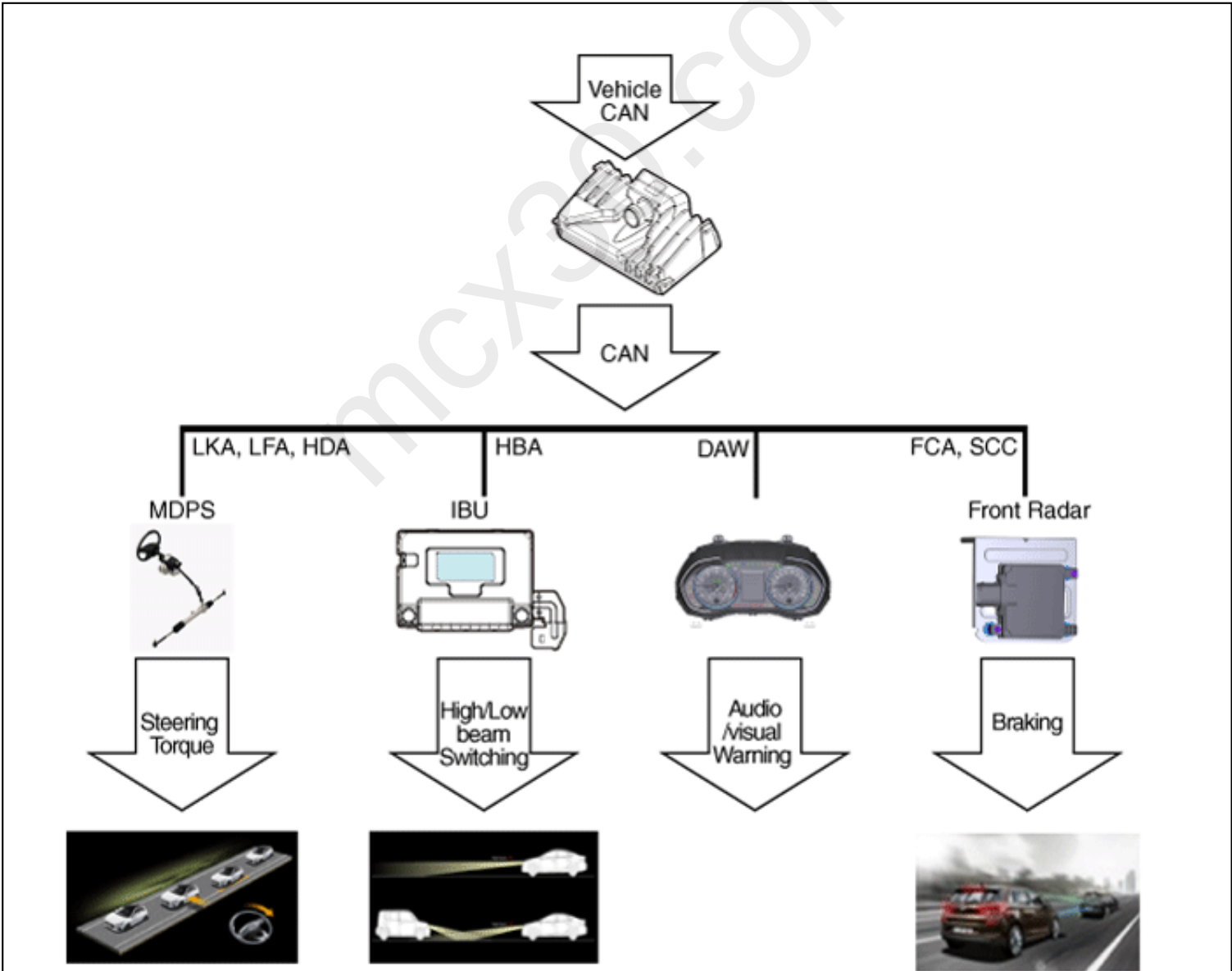
Description and
Operation

Blcok Diagram

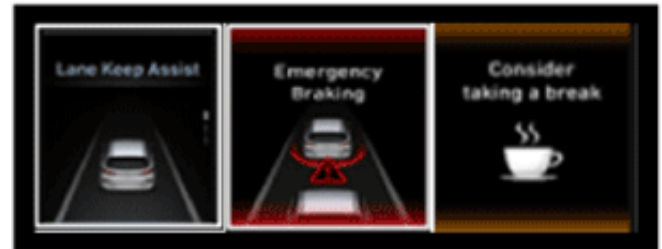
- This system monitors the driving situations through the radar and the camera. Thus, for a situation out of the sensing range, the system may not normally operate.

The System may be limited when :

- The radar sensor or camera is blocked with a foreign object or debris.
- The camera lens is contaminated due to tinted filmed or coated windshield, damaged glass, or stuck of foreign matter (sticker, bug, etc.) on the glass.
- Inclement weather such as heavy rain or snow obscures the field of view of the radar sensor or camera.
- The target in front is too small to be detected
- The vehicle in front is an oversize vehicle or trailer that is too big to be detected by the camera recognition system (for example a tractor trailer, etc.).
- The camera's field of view is not well illuminated (either too dark or too much reflection or too much backlight that obscures the field of view)
- The vehicle in front does not have their rear lights ON or their rear lights are located in an unusual location (modified).
- The windshield glass is fogged up and the clear view of the road has been obstructed.



LKA : Lane Keeping Assist
HBA : High Beam Assist
FCA : Forward Collision-Avoidance Assist
LFA : Lane Keeping Assist
DAW : Driver Attention Warning
HDA : Highway Driving Assist



System Function

The front camera (FR_CMV) supports the following functions by using the data recognized by the front camera (lane / light source / vehicle / pedestrian / motorcycle), and car signals (CAN communication).

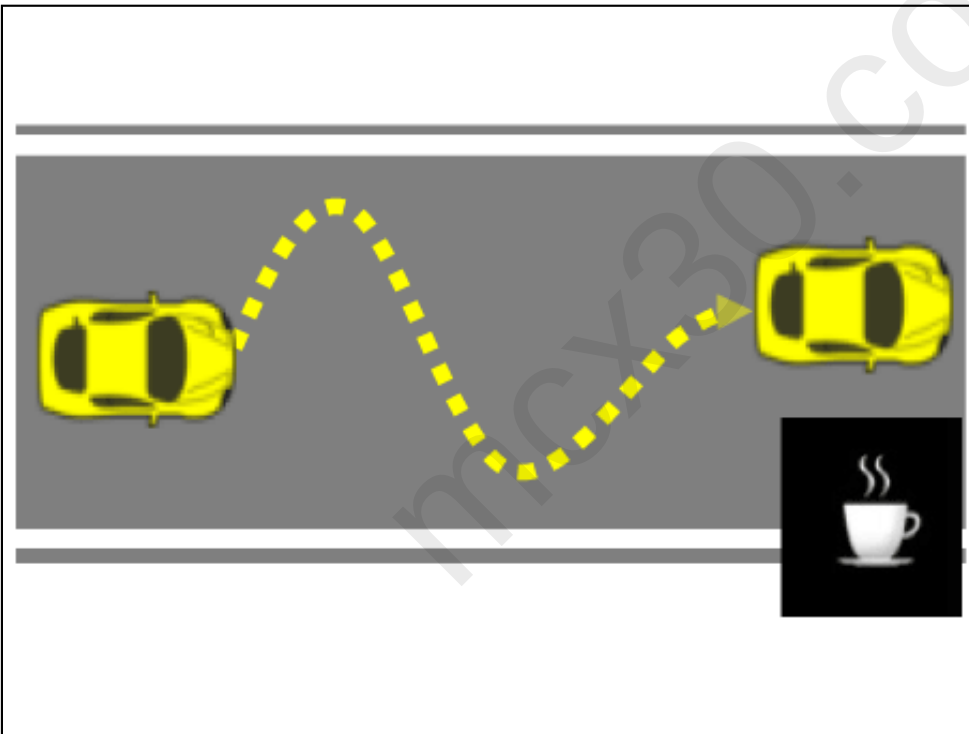
1. Forward Collision-Avoidance Assist (FCA): This driving safety system sends warning to the driver for possible dangers and assists the braking of the vehicle to help avoid collision with any kind of obstacles that are in front of the car while driving. The FCA recognizes the position and the speed of the front obstacles (vehicle / pedestrian / two-wheeled vehicle) using the front camera / forward radar, sends visual / audible warning to the driver when a collision with the front obstacle is expected and helps the driver to avoid the collision by assisting to control the brake. However, the driver must keep an eye on the forward for safety because the front camera / forward radar may not operate normally in certain situations where the obstacles cannot be easily recognized.



2. Lane Keeping Assist (LKA): This driving safety system sends warning to the driver for possible dangers and controls the steering wheel when the system judges that the car is off the lane, reducing the risk of getting into an accident while driving. The LKA sends the driver the visual / audible / tactical warning by using the data about lanes, which is obtained by the front camera, the operational status of the turn signal lights, and helps the driver to avoid the collision by assisting to control the steering wheel. However, the front camera may not operate normally in certain situations where the locations or the boundaries of the lanes are hard to be identified.



3. **Driver Attention Warning (DAW):** This system warns the driver to avoid accidents if it judges that the driver is driving inadvertently. The DAW sends the driver visual and audible warnings if an inadvertent driving is detected by analyzing the driving pattern of the driver in consideration of the lane condition recognized by the front camera and the data on the speed / steering wheel angle / brake operation of the vehicle. However, the front camera may not operate normally in certain situations where the camera fails to obtain data about surroundings.



4. **High Beam Assist (HBA):** This system controls the operation of high beam to improve sight distance as much as possible by minimizing glare from other vehicles when driving at night or with no or less light. By using a forward camera, the HBA identifies where the light comes from, (whether it is from a vehicle in the front / across or a street). When there is light, the system turns the high beam OFF and when there is no light, it turns the high beam ON. However, the front camera may not operate normally in certain situations where the camera fails to obtain data about surroundings.



5. Lane Following Assist (LFA): This system is designed to improve passenger convenience by controlling the steering wheel to keep the vehicle at the center of the lane, helping to reduce operating load while driving. The LFA helps control the steering wheel to keep the car at the center of the lane by using the data about lanes and road boundaries obtained by the front camera. However, the driver must keep an eye on the forward for safety because the system may not operate normally in certain situations where the front camera fails to obtain information about front view.
6. Highway Driving Assist (HDA): This system is a driving convenience system that reduces driver burden while driving on highway or motorway by controlling the vehicle's steering, acceleration and deceleration to maintain the speed set by the driver, keep a safe distance from the vehicle directly ahead, and keep the vehicle in the center of its current lane. HDA uses navigational information to determine whether the vehicle is on highway or motorway. When the vehicle is on highway or motorway, HDA maintains the central position in the lane and the safe distance from the vehicle ahead by controlling steering and acceleration/deceleration in consideration of the lane information detected by the front camera and the relative position/speed detected by the front camera/radar from the vehicle ahead. HDA is canceled when a driver presses the LFA button or SCC button or applies brake. Also, HDA alerts the driver with visual/audible warnings when it judges that driver takes hands off the steering wheel for more than certain time and if the driver still does not hold the steering wheel after the hands-off warning, HDA will be canceled.

System operation

Front camera operating speed by each system :

		Warning [km/h]	FULL Braking [km/h]
Camera FCA	Stationary	5 - 200	5 - 75
	Moving vehicle	5 - 200	5 - 85
	Pedestrians	5 - 85	5 - 65

System	Start [km/h]		Stop [km/h]	
	MIN	MAX	MIN	MAX
LKA	60	200	55	210
DAW	-	210	-	210
HBA	40	200	25	210
LFA	-	180	-	190
HDA	-	180	-	190

The operating conditions of the front camera are as follows when the USM of the following system is ON and the required

operating speed is satisfied.

1. FCA, Forward Collision-Avoidance Assist :

- 1)ESC (Electronic Stability Control unit) must be ON
- 2)It operates when a collision with another vehicle or a pedestrian in front is expected.

2. LKA, Lane Keeping Assist :

- 1)The lane must be clearly identified and both lanes from the opposing directions must be detected.
- 2)The driver should keep its hands on the steering wheel. The system is released if the steering wheel assist system ignores the force of the steering wheel.
- 3)The system starts operating when the lane change is made arbitrarily while the turn signal lights and emergency light switch are being turned OFF.
- 4)If the vehicle exceeds a predetermined width of the vehicle, the system judges that the vehicle moves from one lane to another, and this ends the system.
- 5)The LKA may not work properly in the following conditions when
 - The car drives on a steep curve
 - There is a sudden braking or a sudden lane change.
 - The ESC / VSM is in operation
 - The width of the lane is too wide or too narrow.

3. DAW, Driver Attention Warning :

Inadvertent driving warning

- 1)The DAW (Driver Attention Warning) system may not work properly in the following conditions when
 - The car frequently and deliberately crosses over the lanes or is driven aggressively.
 - The car has to drive on an extremely curving road or uneven surface.
 - If the vehicle is controlled by other lane keeping systems such as ADAS.

Front Vehicle Departure Warning

- 1)When the front vehicle starts running, the system displays a message on the instrument panel along with a beep.
- 2)The Front Vehicle Departure Warning may not work properly in the following conditions when
 - Pedestrians or bicycles are in front.
 - Other vehicle cuts the line.
 - The vehicle standing at the front makes a sudden start or U turn.
 - The vehicle is pulled over at a speed bump, ramp, shoulder, rest area, parking lot.
 - The vehicle stops running while making the right turn or driving on the curved road.
 - The front road condition is unpredictable (ex, a decrease of the number of driving lanes).

4. HBA, High Beam Assist :

- 1)To activate the system, turn the light switch to the 'AUTO' position and slide it towards the instrument panel (High beam : ON).
- 2)The following explains the detailed operation of the High Beam Assist (HBA) System which is controlled by the switch.
When the high beam switch is pushed to the instrument cluster, the operation of the high beam switches to a 'Constant Turned ON' mode and the system ends.
When the light switch is pulled without the high beam being turned OFF, the high beam is turned ON without ending the HBA system.
(When hands are released, the switch moves to the center and turns the high beam OFF.)
When the light switch is pulled with the high beam being turned ON by the HBA, the high beam is turned OFF and the system ends.
The switch of the headlight switch from "Auto" to the "Headlight" turns the high beam OFF and ends the system.
- 3)The high beam is automatically turned OFF when any of the following conditions occurs while the headlight is turned ON by the HBA.HBA
- 4)The system detects the headlight of the other approaching car or the tail light of the front car.
- 5)The system detects the headlight or tail light of bicycles or motorbikes.
- 6)The light condition is bright enough not to turn the headlight ON.
- 7)There is street light or other light in front.

- 8)The light switch is not in the AUTO (auto light) position.
- 9)The USM is OFF or does not meet the required operating speed.
- 10)The system may not operate in a day time even though all conditions for HBA operation are met.

5. **LFA, Lane Following Assist :**

- 1)Press the button of the LFA(Lane Following Assist) system on the steering wheel remote to activate the system.
- 2)The system starts operating when the vehicle is located inside the lane, the lanes of both directions are recognized and there is no sudden turn of the steering wheel by the driver.
- 3)If the lane is not recognized, the system assists the steering wheel control at a limited degree by adapting to different conditions depending on the presence of the other vehicle in front and the running state of the vehicle ahead.
- 4)A hands-off warning occurs when the driver continues to drive the vehicle with his hands-off. The system ends when the driver continues to ignore the warning.
- 5)The LFA system may not work properly in the following conditions, when
 - The vehicle drives on an extremely curving road.
 - The vehicle stops abruptly or makes a sudden lane change.
 - The ESC / VSM is in operation.The width of the lane is too wide or too narrow.

6. **Highway Driving Assist (HDA) :**

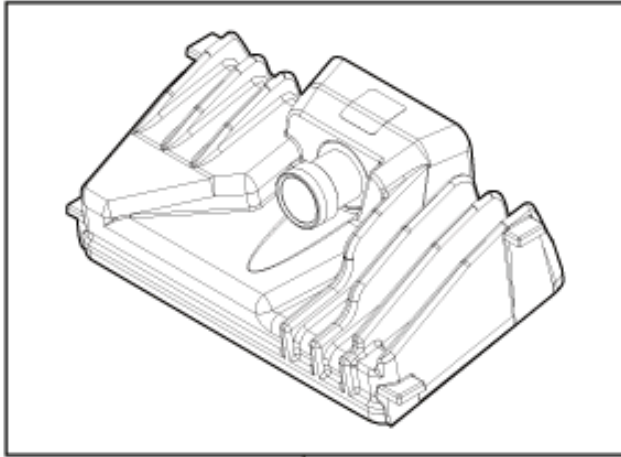
- 1)Fitted without ADAS_DRV
 - It will work automatically when a vehicle is being driven on the highway or motorway and the Smart Cruise Control is operating.
 - It will work automatically when a vehicle enters the main lane on highway or motorway while Smart Cruise Control is operating.
 - The system is canceled when pressing the lane keeping assist button while HDA is operating.
 - A hand-off warning is generated when the driver continues to take off hand from the steering wheel and the system is canceled if the driver does not continue to hold the steering wheel during the hand-off warning.
 - It can respond to cut-in vehicles coming from a short distance.

► NSCC auto speed setting mode

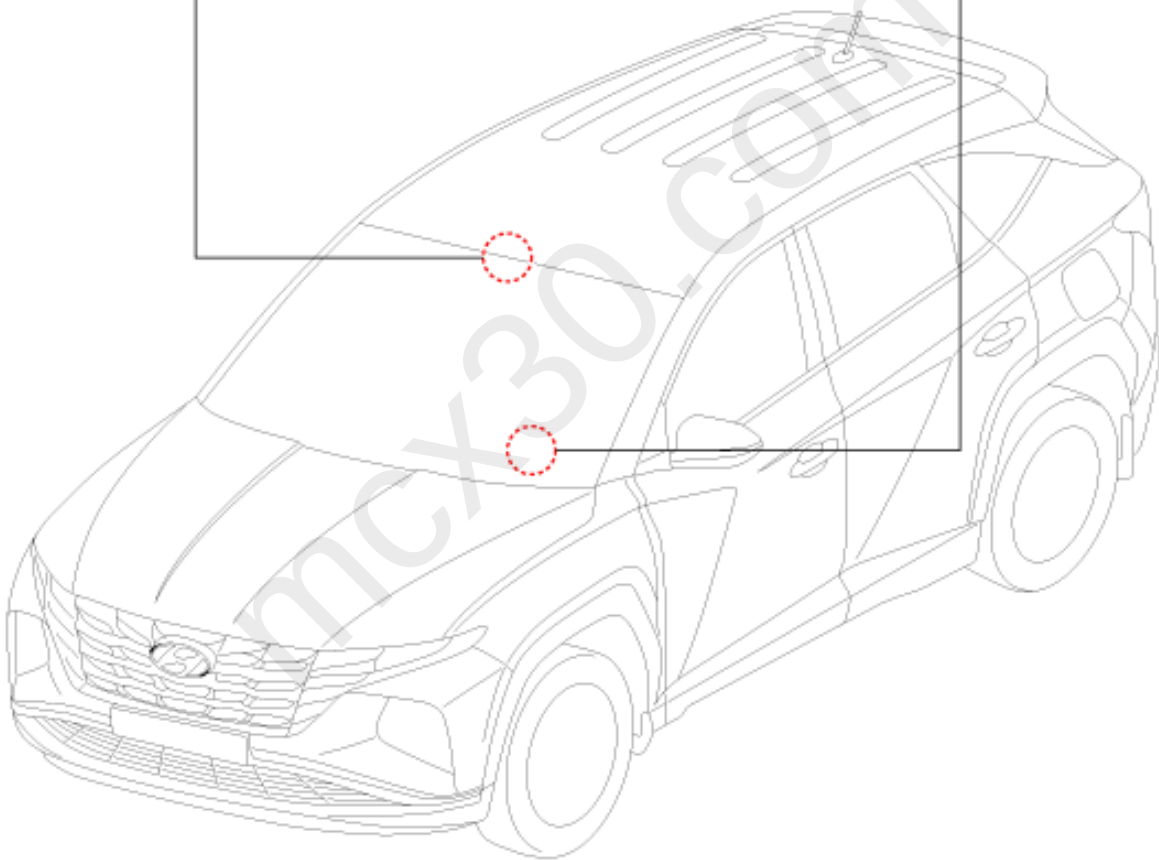
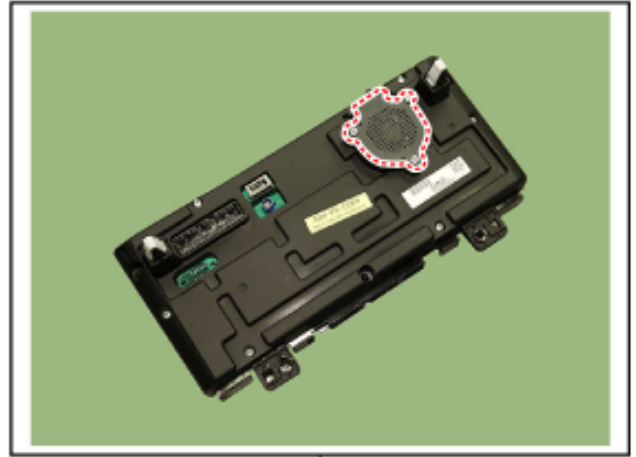
- 1)When NSCC operating conditions are met and the driver's set speed and the speed limit on highway are matched, it will enter the auto speed setting mode.
(Setting speed and 'AUTO' symbol is displayed in green, audible warning sounds)
- 2)The setting speed changes automatically to the changed speed limit with an audible warning in the section where the speed limit is changed on the highway.
- 3)When a driver changes setting speed randomly, 'AUTO' symbol will disappear and the auto speed setting mode is canceled.
- 4)It may not operate or operate abnormally in the following cases
 - When a vehicle is out of main lane such as IC, JC or there is open type tollgate
 - When navigation map information has not been updated
 - When map information is not received by overload as navigations performs various functions simultaneously.
 - When navigation map is different to the actual road due to the map data error or GPS signal is not received.
 - If a driver travels differently than the guided route and navigation does not research the route automatically

Components
Location

[1]



[2]



1. Front camera

2.Speaker (Cluster)



When you need variant coding:
–Replace Front View Camera with a new one
※ EOL Variant Coding and calibration required for new replacement

Front View Camera Variant Coding

Front view camera variant coding makes it possible to operate functions for each vehicle type. If the variant coding differs from the vehicle specification, the "variant coding error" DTC is displayed.

1. Procedure for coding variants

- (1) You should read the specification information for the front view camera that is installed in the vehicle before replacing it with a new front view camera.
- (2) Connect the cable of Diagnostic tool to the data link connector in driver side crash pad lower panel, and turn on the Diagnostic tool.
- (3) Select the 'S/W Management' and 'Car model'.



Service

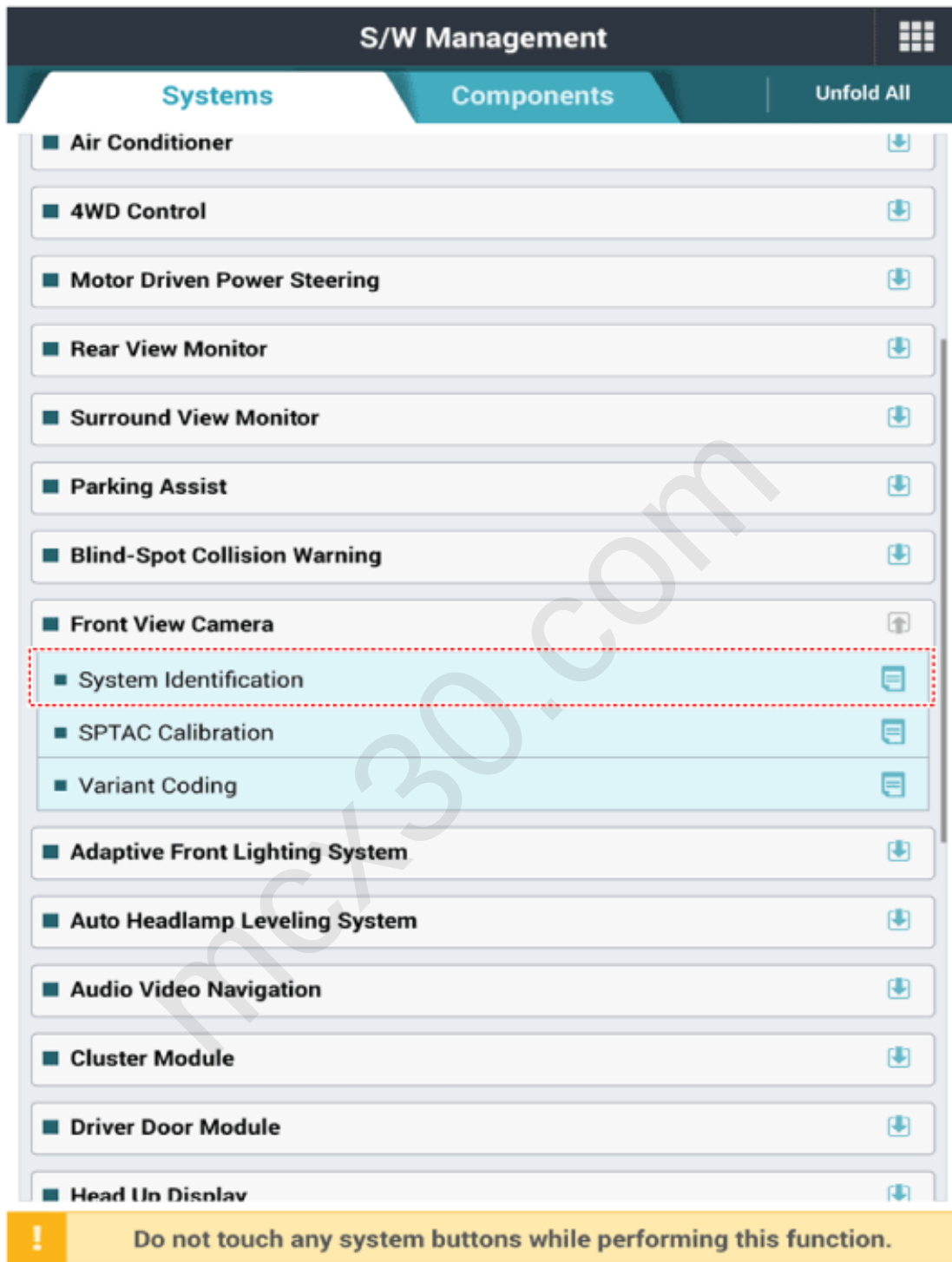
Measurement

OBD- II



NEW THINKING.
NEW POSSIBILITIES.

(4) Select "System Identification".





(5) Select "Variant Coding".



(6) Enter the value of the specification read in procedure(4) in the new front view camera.

Service Point Calibration
(SPC)

When you need calibration:

- Front view camera is removed and mounted
- Replace front view camera with a new one
- Windshield glass changed
- Front view camera coupler of the windshield glass is deformed

Service Point Calibration (SPC)

The following section describes how to calibrate front view camera system using a diagnostic instrument.

[SPC Calibration]



Systems

Components

Fold All

■ Front View Camera	
■ System Identification	
■ SPC Calibration	
■ Variant Coding	
■ Variant coding (BackUp & Input)	

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! Do not touch any system buttons while performing this function.



• SPC Calibration

Purpose	To calibrate the camera focal point when the windshield or Lane Departure Warning System(LDWS) ECU is replaced.
Enable Condition	1. Engine On 2. Vehicle toe-in and tire pressure levels to ensure proper alignment 3. Windscreen must be clean and serigraphy
Concerned Component	Front Camera Module
Concerned DTC	C2720XX, C2721XX, C2722XX
Fail Safe	Warning Lamp On
Etc	1. The left and right sides of the road should be recognized. There should be no fog and rain. 2. Vehicle speed should be over the 36km/h(22.3mph) in the straight road. The test time may be increased at curve street. 3. Progress of the test can be checked. If the progress does not increase more than 1 minute you should be retry in test conditions."

OK



Do not touch any system buttons while performing this function.

S/W Management

■ SPC Calibration

● [SPC Calibration]

The service calibration is required when the windscreen or camera ECU is replaced to set the camera pointing angle parameters.

The front camera module should be programmed with the right vehicle variant coding information before service calibration

Procedure

1) Check of vehicle toe-in and tire pressure levels to ensure proper alignment of the camera to the "world" before proceeding with calibration is suggested.

The vehicle is to be at nominal production loading capacity when the calibration routine is running vehicle trunk/boot weight to be per factory EOL build configuration.

2) Windscreen must be clean and serigraphy checked so that there is no blockage of the camera FOV.

3) Service technician connects the diagnostic connector and starts the vehicle.

If all conditions are met, Press **[OK]** button.

OK

Cancel



Do not touch any system buttons while performing this function.

● [SPC Calibration]

Test Environment Conditions for SPC.

1. The left and right sides of the road should be recognized.

There should be no fog and rain.

2. Vehicle speed should be over the 36km/h in the straight road.

The test time may be increased at curve street.

3. Progress of the test can be checked.

If the progress does not increase more than 1 minute you should be retry in test conditions.

If all conditions are met, Press **OK** button and start driving.

OK

Cancel



Do not touch any system buttons while performing this function.

S/W Management

■ SPC Calibration

Now in progress...

Please wait a moment...

Status : 0 %

Information

The function has been completed.

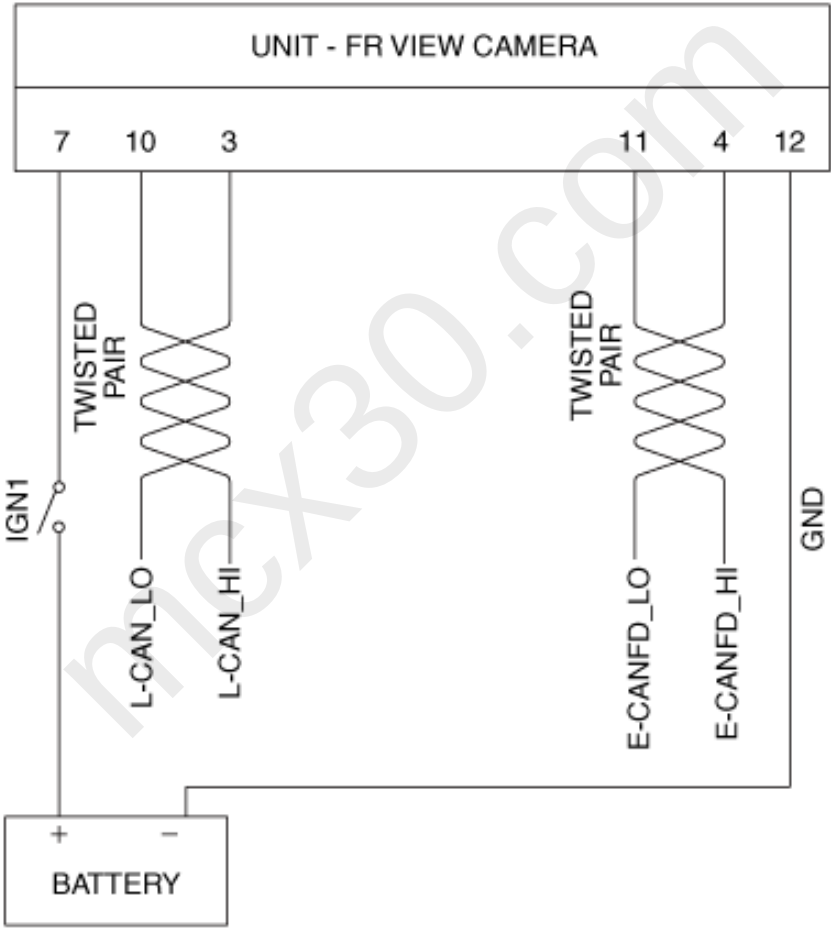
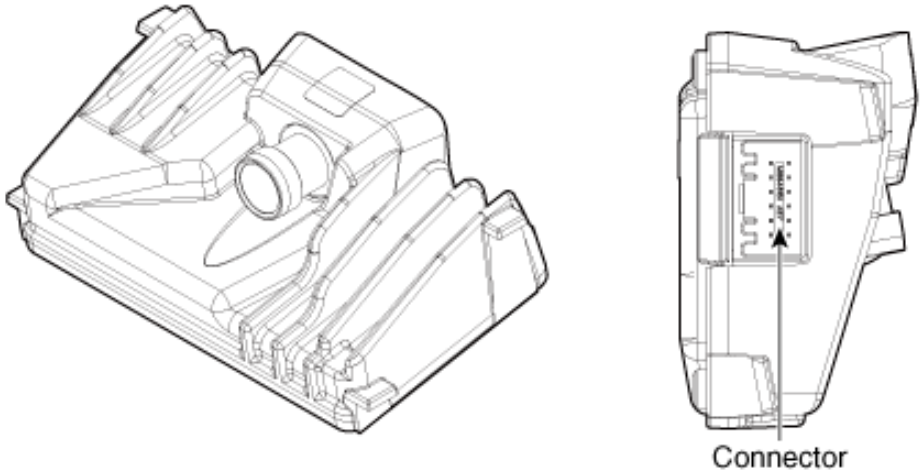
Press **[OK]** button to exit.

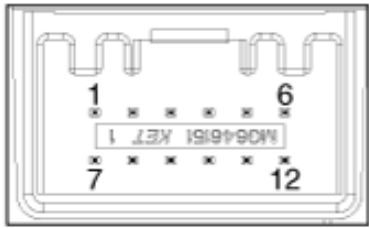
OK

Cancel



Do not touch any system buttons while performing this function.



Connector	Pin NO	Description	Pin NO	Description
	1	-	7	Battery
	2	-	8	-
	3	L-CAN (High)	9	-
	4	E-CAN FD (High)	10	L-CAN (Low)
	5	-	11	E-CAN FD (Low)
	6	-	12	Ground

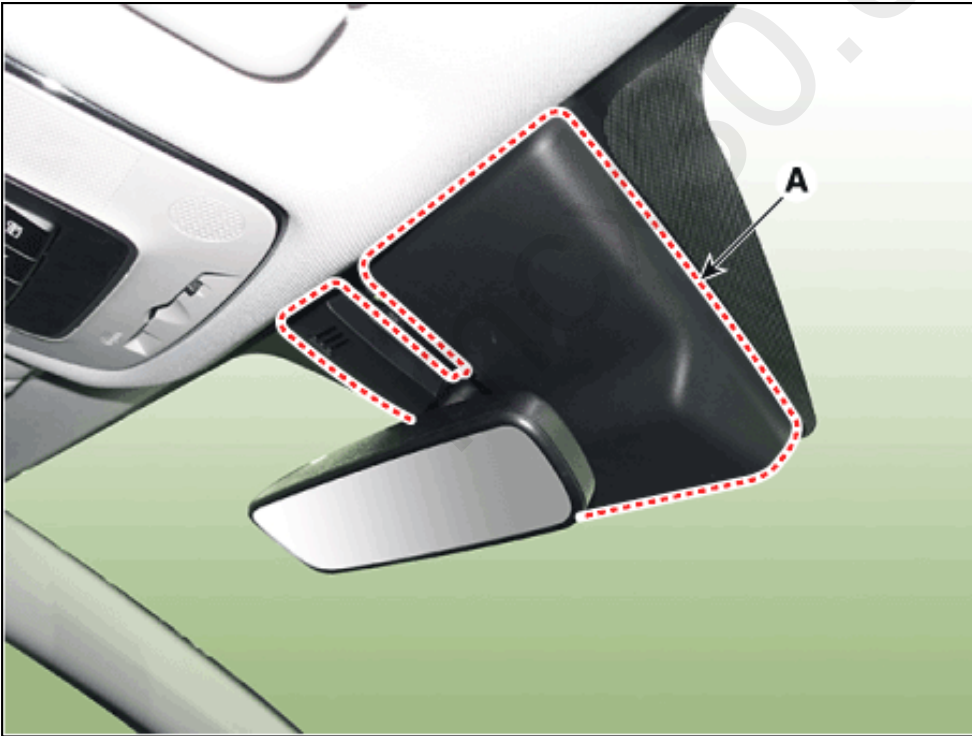
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Removal

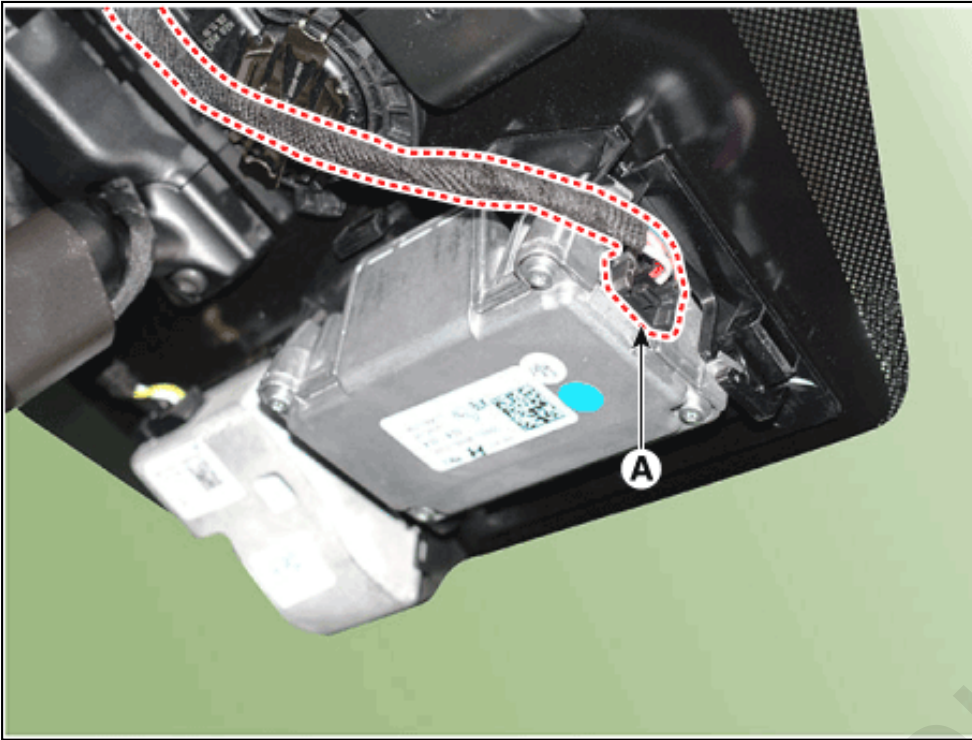
1. Disconnect the negative (-) battery terminal.
2. Remove the inside rear view mirror cover (A)



3. Remove the front view camera cover (A).



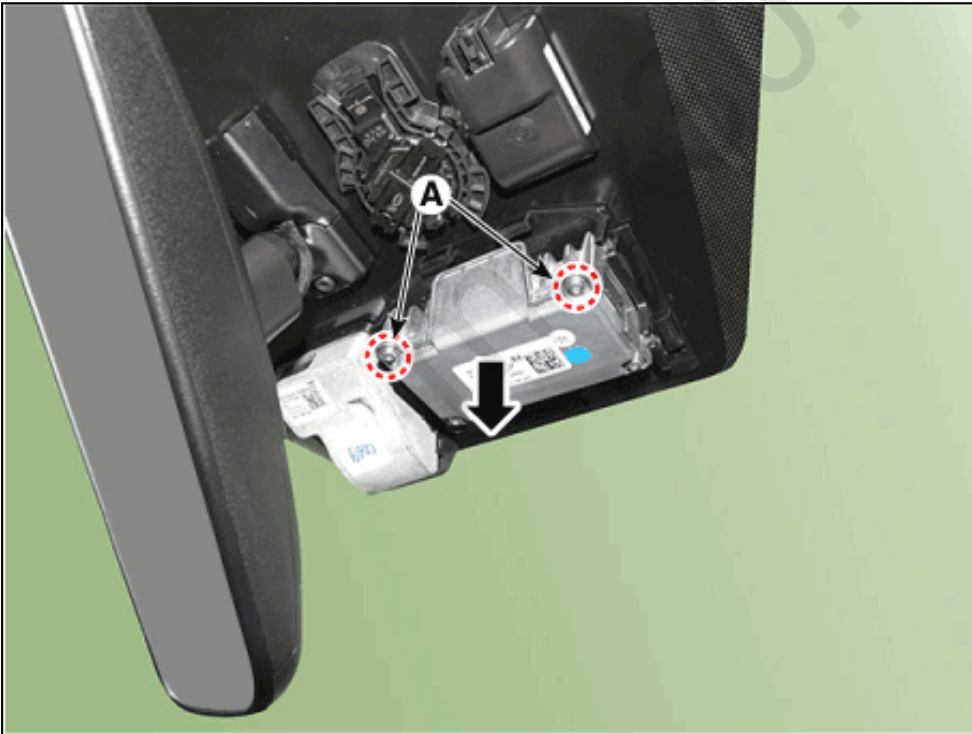
4. Disconnect the front view camera connector (A).



5. Separate the fixed points (A) of coupler and remove the front view camera.



•Be careful not to break the hook (A).

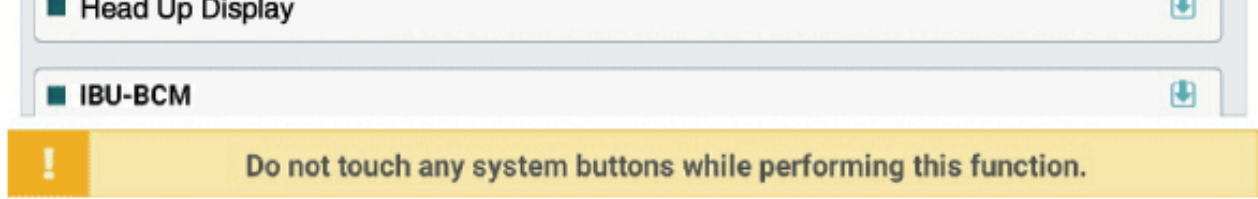


Installation

- Perform the camera calibration in the following case.
(Refer to Front View Camera System - "Repair Procedure")
 - If the front view camera is replaced with a new one.
 - If the front view camera is removed and mounted.
 - If the front view camera coupler of the windshield glass is deformed.
 - If the windshield glass is changed.
 - When a failure code (System Out of Calibration) occur.

1. Install in the reverse order of removal.
2. When replacing the front view camera with a new one, perform the "Variant Coding" procedure by using the Diagnostic Tools.





3. Perform the front view camera unit calibration.
(Refer to Front View Camera System - "Repair Procedure")

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