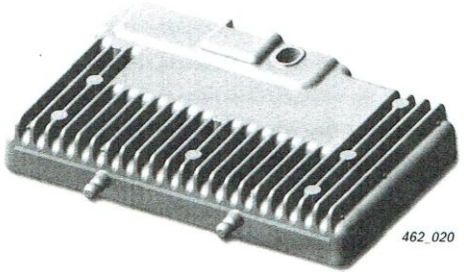
System Components

Night Vision System Control Module J853

J853 is the central control module for Night Vision Assist.

It performs the following tasks:

- Processes the raw images produced by the Night Vision Assist camera
- Detects and marks people in thermal image
- Continuously evaluates camera images and computes the potential danger of a collision with a detected person
- Warns when danger of a collision is detected
- Transfers processed thermal images to the instrument cluster
- Receives and processes variables and information required for the operation of Night Vision Assist as a CAN Extended user
- Supplies the infrared camera with battery power
- Continuously diagnoses the system and logs any detected faults in fault memory
- Aids troubleshooting of the Night Vision Assist system by providing data blocks, adaptations, and actuator diagnoses
- Provides the software required for calibrating the system at service centers and during production
- Performs dynamic calibration under defined conditions while driving
- Saves the customer's Night Vision Assist settings for the ignition key in use



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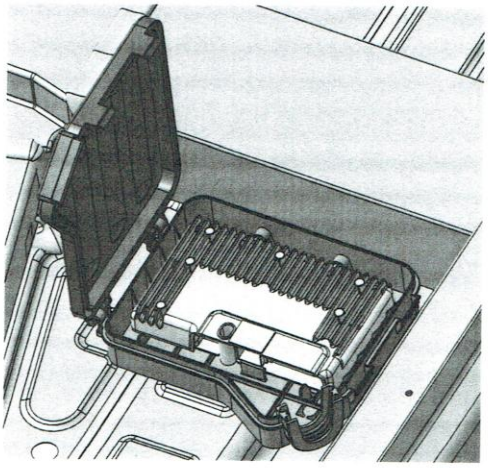
Installation Location

J853 is located in front of the left front seat in the vehicle floorpan, mounted in a plastic protective housing.



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Component Protection

J853 is integrated into the component protection system. The control module must be adapted to the vehicle to enable its functions.

If a new module is installed, it must be adapted to the vehicle online using the VAS Scan Tool.

Infrared Camera R212

R212 has its own CPU. In addition to recording "raw" images and transferring these images to the Night Vision Assist control module, it has the task of storing calibration data. Calibration data is not stored in Night Vision System Control Module J853, but rather in the camera. This saves having to recalibrate the camera after replacing a defective control module.

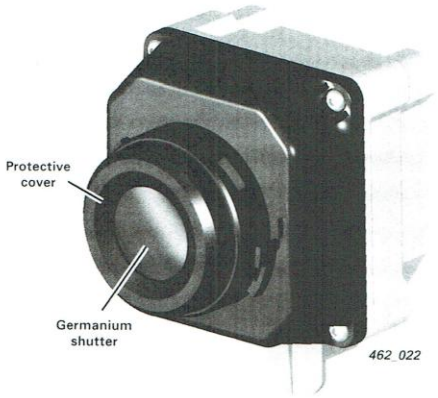
The camera is an infrared thermal image camera which, like J853, is sourced from systems supplier Autoliv. The camera has its maximum sensitivity at long infrared wavelengths, which are invisible to the human eye.

The camera produces a black-and-white image. It has a horizontal resolution of 320 pixels and a vertical resolution of 240 pixels at 30 frames per second.

To protect the camera against stone chip damage, it has a protective shutter in front of the lens. The shutter is made of germanium. It was not possible to manufacture the shutter from glass because glass is not permeable to heat radiation.

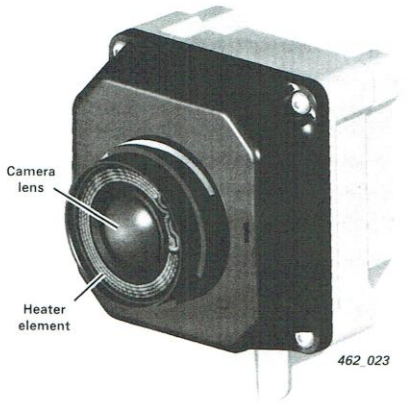
In the unlikely event that the protective shutter is damaged by stone chips, it can be replaced together with the protective cover. Both components are available as a repair kit.

A separate spray jet is installed for cleaning the camera's protective shutter. When the spray nozzles of the headlight washer system are activated, the spray jet is also activated to remove any existing dirt from the lens.



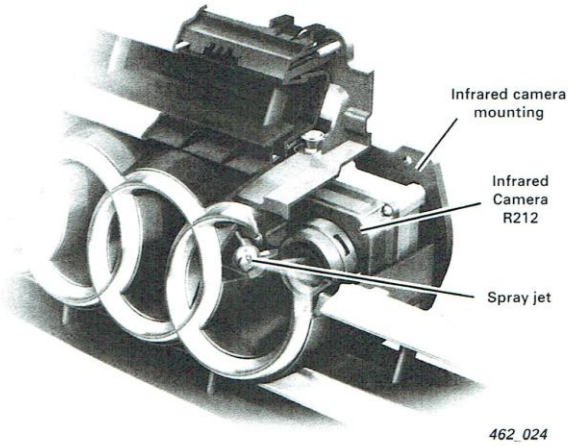
Camera Shutter Heater

Since the Night Vision Assist camera is built into the Audi rings on the vehicle's radiator grille, there is a danger of it icing up in wintery conditions. The protective shutter will be heated if the camera is in danger of icing up at ambient temperatures below 42.8°F (6°C). The temperature is recorded by a separate temperature sensor in the camera. Heating current is regulated according to ambient temperature.



Installation Location of R212

R212 is built into the right ring, as seen from the front, of the Audi rings on the radiator grille.



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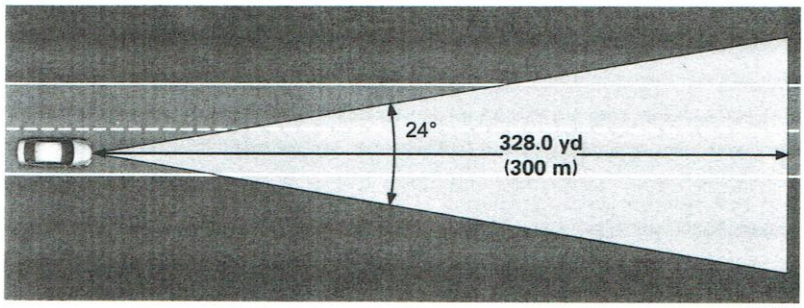
Camera Range

Night Vision Assist has a range of approximately 328.0 yds (300 m). The camera has a horizontal opening angle of 24°.



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Protection Against Misuse of Thermal Imaging Camera

Thermal imaging cameras were originally developed for military applications. Today they are increasingly used in civilian applications. The use and trading of thermal imaging technology is still subject to restrictions. The Audi system's thermal imaging camera has an electronic security mechanism which prevents the camera from producing a thermal image without an accompanying control module specifically initialized for each Audi vehicle.

A thermal image will only be displayed if the camera and control module are able to communicate with one another via the private bus lines.

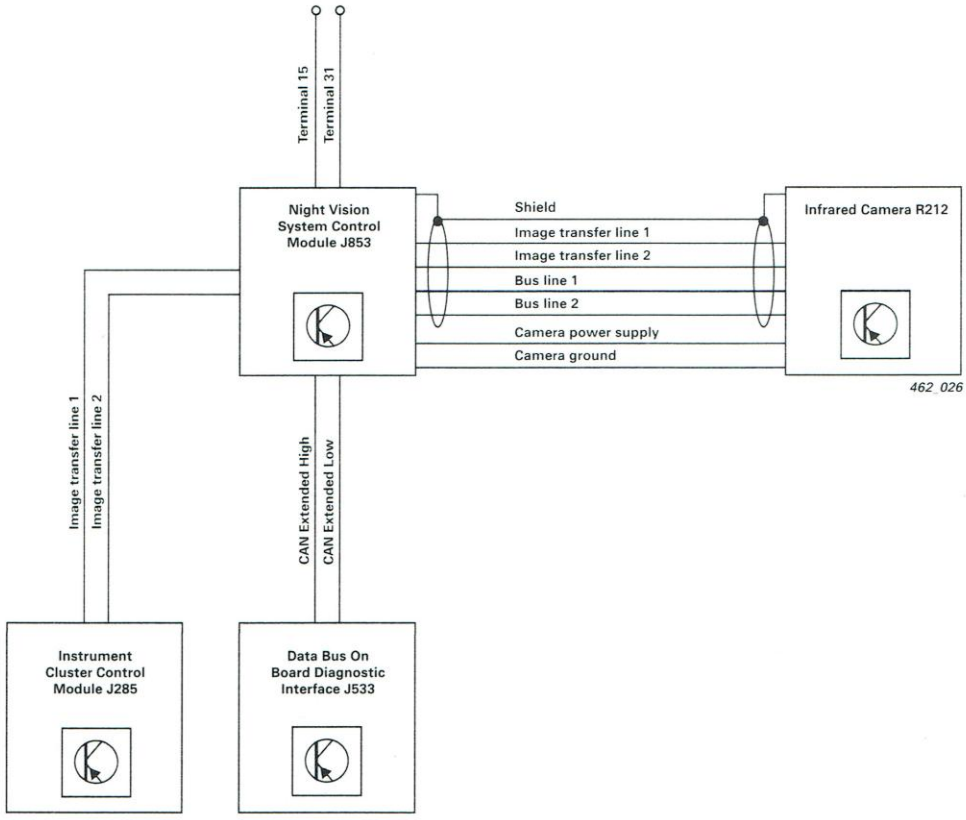
Functional Diagram

Night Vision System Control Module J853 is a "terminal 15" control module and has a "terminal 15" line and a "terminal 31" line for independent power supply.

It communicates with Infrared Camera R212 via two private bus lines. Diagnostic information, data, and commands are transferred across this line.

The raw image produced by the camera is transmitted to the control module via two image transfer lines. Both bus lines and the image transfer lines are commonly shielded.

Two supply lines go from the control module to the camera. The control module supplies the camera with battery power.



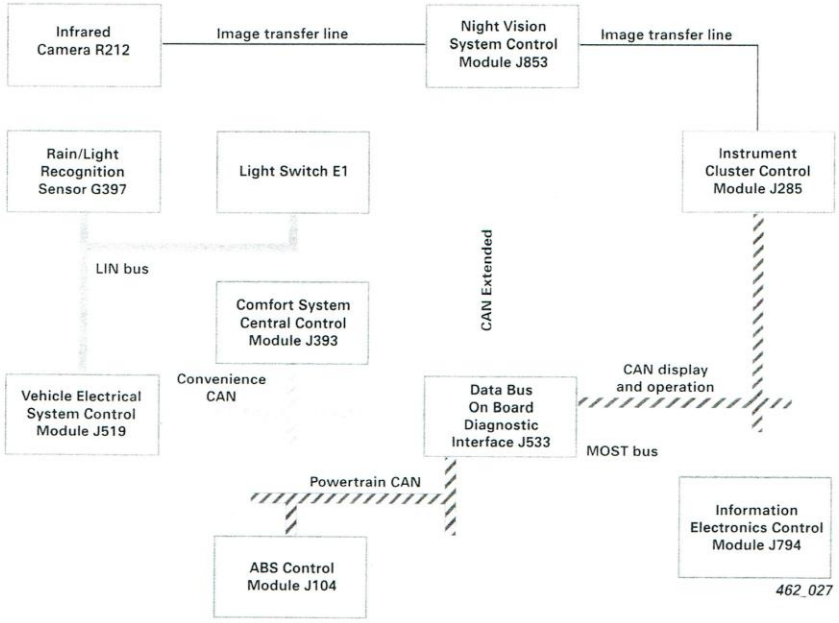
A sheathed and unshielded line with two twisted cores goes from Night Vision System Control Module J853 to Instrument Cluster Control Module J285. An analog video signal is transferred to the multi-function display via this line.

To interchange data with other control modules, two CAN Extended bus lines lead to Data Bus On Board Diagnostic Interface J533, which exchanges data between the CAN Extended bus and other bus systems.

Communication Structure

To operate the overall Night Vision Assist system in the vehicle, Night Vision System Control Module J853 requires large volumes of data.

This data is sourced from other control modules, which communicate with each other via various LIN, CAN, FlexRay, and MOST bus systems.



Night Vision System CM J853

- Receives CAN messages containing variables and content required for its operation
- Transfers the processed thermal image to the Driver Information System display
- Transfers information to the Driver Information System display

Data Bus On Board Diagnostic Interface J533

- Forms the interface between various CAN bus systems and FlexRay
- Master control module for the component protection system

Instrument Cluster CM J285

- Displays the image produced by the Night Vision Assist camera
- Outputs an acoustic signal during a warning
- Displays driver information relating to the Night Vision system
- Displays error messages
- Transfers filtered ambient temperature to J853

Information Electronics CM J853

- Customer can make various adjustments to Night Vision Assist via the MMI

Comfort System Central CM J393

- Sends the "terminal 15" bit electronically for validation purposes

Vehicle Electrical System CM J519

- LIN master of Rain/Light Recognition Sensor G397 and Light Switch E1

Rain/Light Recognition Sensor G397

- Signals the currently measured brightness level

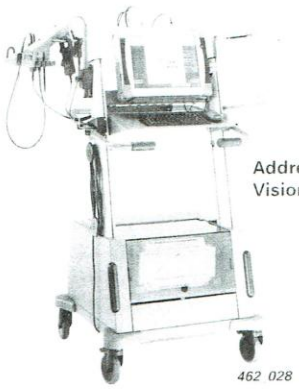
Light Switch E1

- Signals that the Night Vision Assist button has been pressed
- Signals the current position of the rotary light switch

ABS CM J104

- Signals current vehicle speed
- Signals current yaw rate

Diagnostic Functions and System Calibration



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Address word 84 is assigned to Night Vision Assist in the VAS Scan Tool

Data Blocks

The following information can be read through the Measuring Value Blocks:

- Control module power supply
- Current control module temperature
- Saved maximum and minimum temperature values of the control module with time stamp
- Stored maximum and minimum temperature values of camera with time stamp
- Current status of the shutter* (open/closed)
- Camera heater (ON/OFF)
- Camera display information
- Low beam headlights (ON/OFF)
- Number of faulty camera pixels
- Night Vision Assist button (pressed/not pressed)
- Number of recorded frames per second

Preferences

("Marking of detected pedestrians": ON/OFF; "Warning gong": ON/OFF; image contrast)

- ▶ Preferences stored for key 1
- ▶ Preferences stored for key 2
- ▶ Preferences stored for key 3
- ▶ Preferences stored for key 4

- Current yaw rate
- Dynamic calibration:
  - ▶ Current status (running/not running)
  - ▶ Distance travelled with active dynamic calibration
  - ▶ Calculated dive angle
  - ▶ Calculated yaw angle
- Current brightness level of rain/light sensor
- Roll angle, yaw angle, and dive angle of static calibration
- Yaw angle and dive angle of dynamic calibration
- Abort condition of last static calibration
- Time stamp of last static calibration and VIN
- Reasons for deactivation of pedestrian detection function (with brightness and ambient temperature values)
- Number of keys currently in use
- Current vehicle speed
- System and display status information

* Shutter — For temperature calibration purposes, the shutter is moved in front of the image capture chip every two minutes.

- Night Vision Assist camera power supply
- Current power consumption of Night Vision Assist camera
- Current camera temperature

Adaptations

The following functions are available under Adaptations:

- Reset stored minimum and maximum camera temperature
- Reset stored minimum and maximum temperature of the Night Vision Assist control module
- Switch Night Vision Assist (ON/OFF)

System Calibration

When does the system have to be recalibrated?

- Replacement of the Infrared Camera
- Replacement of the camera mounting
- Replacement or removal of the front bumper
- If the fault memory of the Night Vision Assist control module contains the entry "No or wrong basic setting"
- Adjustment work on the rear axle

When does the system NOT have to be recalibrated?

- Replacement of Night Vision System Control Module J853
- Flashing Night Vision System Control Module J853

Output Check Diagnosis

The following components can be tested using the Output Check Diagnosis:

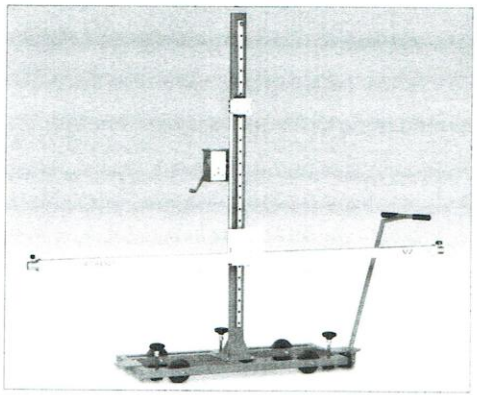
- Night Vision Assist camera heater
- Mechanical camera shutter
- Temporary activation of component protection system

The actuator diagnostics can be used to start a software routine which determines how many camera pixels are faulty. This check takes between two and three minutes.

A test picture can be viewed on the Driver Information System display by a different Output Check Diagnosis.

The following special tools are required for calibration of the Night Vision Assist system:

- VAS Scan Tool
- Wheel alignment computer (VAS 6141)
- Calibrating device, basic kit VAS 6340/1 or calibrating device VAS 6430
- Night vision system calibration plate VAS 6430/6
- Linear laser VAS 6350/3)



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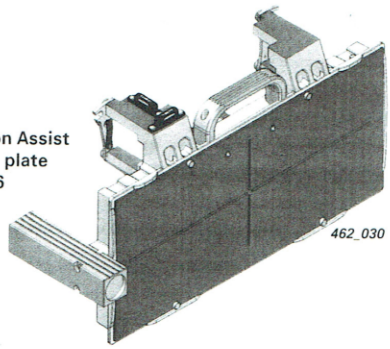
Calibrating device, basic kit VAS 6430/1, which is also used for calibration of Audi Lane Assist and Adaptive Cruise Control (ACC)

Night Vision Assist calibration plate VAS 6430/6



Calibration Process

To calibrate the Night Vision Assist camera, follow these steps:

1. Place calibration plate VAS 6430/6 on the adjustment beam of VAS 6430/1
2. Position calibrating device VAS 6430/1 at a distance of 47.2 in (120 cm) in front of camera
3. Start the calibration routine for Night Vision Assist in the wheel alignment computer
4. Height adjustment of calibration plate VAS 6430/6: the height of the calibration plate can be set correctly by turning the crank on the back of the calibration panel
5. To compensate for surface unevenness, place spirit level 1 on the calibration plate and make sure it is level
6. Move the calibrating device into the correct transversal position by shifting it sideways (the wheel alignment computer indicates when a suitable position is reached)
7. Make sure spirit levels 1 and 2 are level using the two adjustment screws
8. Again check the height adjustment using the linear laser, and correct it as needed
9. Activate the heating function of calibration plate VAS 6430/6
10. Select and start the program "J853 — Calibration" on the VAS Scan Tool

    This is a two-step program:

    The first step is to mechanically calibrate the roll angle of the Night Vision Assist camera. The camera must be aligned horizontally by turning the calibration screw using a hexagon socket.

    The required direction of rotation is predefined by guided fault finding, which will also indicate when the nominal roll angle is reached.

    The second step involves calculating the yaw and dive angles and storing them in the Night Vision Assist camera. This step is carried out automatically.

Results of Calibration

Calibrating the Night Vision Assist camera produces the following results:

- Mechanically correct camera roll angle setting
- Static camera yaw angle which is corrected electronically by the control module
- Static camera dive angle which is also corrected electronically

Note

If it is necessary to calibrate Adaptive Cruise Control (ACC) in addition to Night Vision Assist, the set distance to the calibrating device can also be used for calibrating ACC. However, it is important to observe the sequence of calibration: calibrate Night Vision Assist first, then ACC.

To calibrate Audi Lane Assist, however, the calibrating device has to be re-aligned.

Dynamic Calibration

Night Vision Assist also has dynamic calibration capability. This system starts to run whenever a horizon is detected. The conditions for detecting a horizon are best when driving on country roads or highways.

The dynamic calibration system determines deviations in camera yaw and dive angles from the values obtained by the static calibration. These angular deviations are factored into the calculations for electronic correction of the camera image.

If the calculated angular deviations in dynamic calibration exceed a limit value, "No or incorrect basic setting" will be logged in the fault memory entry of Night Vision System Control Module J853. This fault memory entry means that a new static calibration must be performed. One possible reason for this is that the thermal imaging camera has been knocked out of alignment after a minor parking collision.

The roll angle of the thermal imaging camera, which can be adjusted mechanically, is not an integral part of the dynamic calibration.