



***ADVANCED DRIVER
ASSISTANCE SYSTEMS (ADAS)
SPECIALIST TEST (L4)***

COMPOSITE VEHICLE TYPE 1

REFERENCE DOCUMENT

This document is intended only for reference when preparing for and taking the ASE Advanced Driver Assistance Systems (ADAS) Specialist Test. The composite vehicle Type 1 Advanced Driver Assistance Systems are based on designs common to many vehicle manufacturers, but is not identical to any actual production vehicle.

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INTRODUCTION

ASE Composite Vehicle Type 1 was conceived and built by technical committees of industry experts to accommodate high level diagnostic questions on the L4 test. While some aspects of this Composite Vehicle may appear similar to vehicles from a number of manufacturers, it is important to understand this vehicle is a unique design and is NOT intended to represent any specific make or model. For the purposes of this test, the composite vehicle does not use the process known as sensor fusion for any system except Automatic Emergency Braking. This reference document should be used when answering questions identified as Composite Vehicle questions.

Note: The reference materials and questions for this test use terms and acronyms that are consistent with SAE standards J1930 and J3063.

ADVANCED DRIVER ASSISTANCE SYSTEMS (ADAS) DEFINED

Safety systems which are designed to assist the driver in both normal driving modes and pre-collision avoidance. These systems rely on the use of numerous specialized sensors and cameras that often require calibration in order to operate properly. Calibration can be static, dynamic or a combination of the two. Advanced driver assistance system functions are categorized into:

- **Passive functions** – the vehicle will warn the driver in the form of a warning light, warning message, an audible indication (tone) and/or haptic feedback (vibration) when sensing potentially dangerous situations.
- **Active functions** – the vehicle can take corrective actions when sensing potentially dangerous situations.

SYSTEMS

ADAPTIVE CRUISE CONTROL (ACC)

When enabled, performs longitudinal control of the vehicle to maintain a user-selected speed and following distance.

- The forward radar module and multifunction forward facing camera are the primary inputs.
- ACC parameters are adjusted using the instrument cluster module (ICM) interface.
- ACC system settings are controlled using the ACC switch located on the steering wheel.
- Can be enabled in any forward gear between 20 and 90 mph (between 32.2 and 144.8 km/h)

AUTOMATIC EMERGENCY BRAKING (AEB)

Using sensor fusion and inputs from other vehicle systems, detects potential collisions and automatically applies the brake to provide collision mitigation if a collision is imminent.

- System active in any forward gear with vehicle speed above 5 mph (8.0 km/h).
- System can be turned OFF using the ADAS control panel switch.
- When the ignition switch is cycled from ON to OFF, the system defaults to ON.

BLIND SPOT WARNING (BSW)

Detects vehicles in adjacent lanes to the rear and alerts driver to their presence. If a vehicle is present in the blind spot detection zone, the blind spot warning indicator will illuminate. While attempting to change lanes, if a vehicle is present in the blind spot detection zone the corresponding blind spot warning indicator will flash and the system will use the electronic power steering (EPS) to resist the lane change. When the turn signal switch is activated, the EPS resistance is bypassed.

- The left and right rear corner radar modules are the primary inputs.
- System can be turned OFF using the ADAS control panel switch.
- When the ignition switch is cycled from ON to OFF the system defaults to ON.
- Parameters can be adjusted using the infotainment display center.
- Active in any forward or reverse gear at vehicle speed 25 mph (40.2 km/h) and above.

ELECTRONIC BRAKE CONTROL (EBC)

- Through the vehicle networks, the ADAS central control module can request brake application by the EBC module.

FORWARD COLLISION WARNING (FCW)

Provides a warning to the driver when an impending forward collision is detected. When a collision becomes imminent, the system will engage the automatic emergency braking (AEB).

- The forward radar module and multifunction forward facing camera module are the primary inputs.
- System can not be turned OFF.
- System active in any forward gear with vehicle between 3 and 95 mph (between 4.8 and 152.9 km/h).

LANE KEEP ASSISTANCE (LKA)

Monitors the vehicle's position within a driving lane and alerts driver as the vehicle approaches or crosses lane markers. If the vehicle departs its driving lane, the system will provide steering support to return and maintain the vehicle within its lane.

- The multifunction forward facing camera module is the primary input.
- System can be turned OFF using the ADAS control panel switch.
- When the ignition switch is cycled from ON to OFF, the system defaults to ON.
- Parameters can be adjusted using the infotainment display center.
- System active in any forward gear with vehicle above 25 mph (40.2 km/h).

PARKING COLLISION WARNING (PCW)

During low-speed parking maneuvers, detects objects in close proximity to the vehicle and provides an audible warning to the driver. As the distance between the vehicle and the object decreases, the frequency of the audio alert increases.

- Ultrasonic sensors (front and rear) are the primary inputs.
- System active in any forward gear or reverse with vehicle between 2 mph and 8 mph (3.2 km/h and 12.9 km/h).
- System can be turned OFF using the ADAS control panel switch.
- When the ignition switch is cycled from ON to OFF, the system defaults to ON.
- System does not require calibration.

POWERTRAIN CONTROL SYSTEMS

Through the vehicle networks, ADAS central module can request a change of engine torque output via the engine control module (ECM) and transmission control module (TCM) for collision mitigation and adaptive cruise control.

REAR CROSS TRAFFIC WARNING

Detects traffic approaching from the side at the rear of the vehicle and provides an audio warning to the driver when a possible cross traffic collision is detected.

- The rear corner radar modules are the primary inputs.
- System can be turned OFF using the ADAS control panel switch.
- When the ignition switch is cycled from ON to OFF, the system defaults to ON.
- System active in reverse with vehicle speed below 5 mph (8.0 km/h).

SURROUND VIEW

The surround view system generates a realistic, animated top-down display of the vehicle that provides the driver with a detailed image of the vehicle's exterior surroundings. Created by combining images from the front, left-side, right-side and rear surround view cameras.

- The surround view camera module and cameras (front, rear, left, right) are the primary inputs.
- Parameters can be adjusted using the infotainment display module.
- In forward gears the infotainment system will display at top down view of the vehicle when vehicle speed is 5 mph (8.0 km/h) and below.
- In reverse gear the infotainment system will display at top down view and rear camera view of the vehicle on a split screen when vehicle speed is 5 mph (8.0 km/h) and below.

CONTROL MODULES

ADAS CENTRAL CONTROL MODULE

Analyzes data from all ADAS modules to make timely safety-related decisions such as automatic emergency braking and front collision warnings.

- ADAS data is communicated over the ADAS CAN bus. If the ADAS Can bus fails, the ADAS central control module can communicate with other modules using the vehicle CAN bus as a back-up/redundant CAN bus to control limited ADAS functions.
- Programming and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Contains a 120-ohm terminating resistor for the ADAS CAN bus.
- Receives supply voltage from the ignition switch.

ELECTRONIC BRAKE CONTROL (EBC) MODULE

Analyzes wheel speed, other inputs and network data to electronically raise or lower hydraulic brake pressure using a hydraulic control module that includes an electric pump and solenoids to maintain vehicle stability and/or provide automatic emergency braking.

- Contains the brake pressure sensors, yaw rate sensor, longitudinal G sensor, lateral G sensor, and hydraulic control unit.
- ADAS data is communicated over the Vehicle CAN bus.
- Programming, initialization, and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Initialization required during module replacement.
- Receives supply voltage from the battery and switched voltage from the ignition switch.

ELECTRONIC POWER STEERING (EPS) MODULE

Analyzes direct inputs and network data to control vehicle steering including power steering, lane keeping assistance and collision mitigation functions. Controls an integral electric motor to provide directional control to the driver and the ADAS. Analyzes data from the network to provide intuitive outputs to the steering wheel vibration actuator.

- Located integral with the steering rack assembly.
- ADAS data is communicated over the Vehicle CAN bus.
- Programming, initialization, and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Initialization required during module replacement.
- Receives supply voltage from the battery and switched voltage from the ignition switch.

ENGINE CONTROL MODULE (ECM)

Controls the engine through various outputs and actuators in response to direct and network inputs. Assists with adaptive cruise control, collision mitigation, and stability control functions through throttle control.

- ADAS data is communicated over the Vehicle CAN bus.
- Contains a 120-ohm terminating resistor for the Vehicle CAN Bus.
- Programming, coding, initialization, and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Initialization required during module replacement.
- Receives supply voltage from the battery and switched voltage from the ignition switch.

FORWARD RADAR MODULE

Assists in collision mitigation by evaluating closing rates of objects using radar waves to determine the distance to objects in the vehicle's path of travel.

- Provides input to the adaptive cruise control (ACC) and the forward collision warning (FCW) systems.
- Mounted in non-adjustable, non-repairable bracket directly to the center of the front grille.
- Base adjustment is completed using adjustment screws on the forward radar module. (See diagram below.)
- 77 Ghz radar sensor.
- Range of 0-200 meters (0-660 ft.).
- ADAS data is communicated over the ADAS CAN bus.
- Calibrated using a static procedure.
- Programming, coding, initialization calibrations, and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Replacement module must be programmed, coded, and initialized before calibration can be performed.
- Receives supply voltage from the ignition switch.



GATEWAY MODULE

The central hub that securely and reliably interconnects and processes data across the vehicle networks. Provides a secure gateway that prevents access or data collection through other modules on the data networks without proper authorization.

- Contains three 120-ohm terminating resistors: one for the ADAS CAN bus, one for the vehicle CAN bus, and one for the diagnostic CAN bus.
- Programming, coding, initialization and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Receives supply voltage from the battery and switched voltage from the ignition switch.

GPS ANTENNA MODULE

Receives and interprets GPS data from satellites and communicates it to the audio/video infotainment display module and telematics control module.

- Located on the roof of vehicle integral with the GPS antenna.
- Communicates high speed data through coaxial cables.
- Receives supply voltage from the battery and switched voltage from the ignition switch.

INFOTAINMENT DISPLAY MODULE

Processes audio, video, and network signals to deliver entertainment and information to the driver and passengers.

- Display for back-up camera, GPS, and surround view system.
- ADAS data is communicated over the ADAS CAN bus.
- Programming, coding, initialization and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Receives power from the battery and ignition switch.
- Allows ADAS parameter adjustment via input from driver.

INSTRUMENT CLUSTER PANEL (ICP) MODULE

Combination analog and digital display that displays vehicle data and warnings. Includes a message center to display vehicle warnings, information flags and messages. Includes an interface to ADAS settings.

- Can be configured to display either English or metric parameters.
- Programming, coding, initialization and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Initialization required during module replacement.
- ADAS data is communicated over the Vehicle Can bus.
- Receives supply voltage from the battery and switched voltage from the ignition switch.

MULTIFUNCTION FORWARD FACING CAMERA MODULE

Captures and processes the images to detect lane markers, lights, vehicles, pedestrians, objects and traffic signs.

- Mounted to a non-adjustable, non-repairable bracket bonded to the windshield above the rearview mirror.
- Monocular style camera.
- ADAS data is communicated over the ADAS CAN bus.
- Input to the adaptive cruise control (ACC), forward collision warning (FCW) and lane keep assistance (LKA).
- Programming, coding, initialization and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Controls the forward-facing camera heater.
- Calibrated using a combination of static and dynamic procedures.
- Receives supply voltage from the ignition switch.
- Camera lens can not be cleaned. If lens is dirty, camera must be replaced.

PARKING COLLISION WARNING (PCW) SYSTEM MODULE

Analyzes data from the ultrasonic sensors as an input for ADAS.

- ADAS data is communicated over the ADAS CAN bus.
- Programming, coding, initialization, and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Initialization is required during module replacement.
- Receives supply voltage from the battery and switched voltage from the ignition switch.

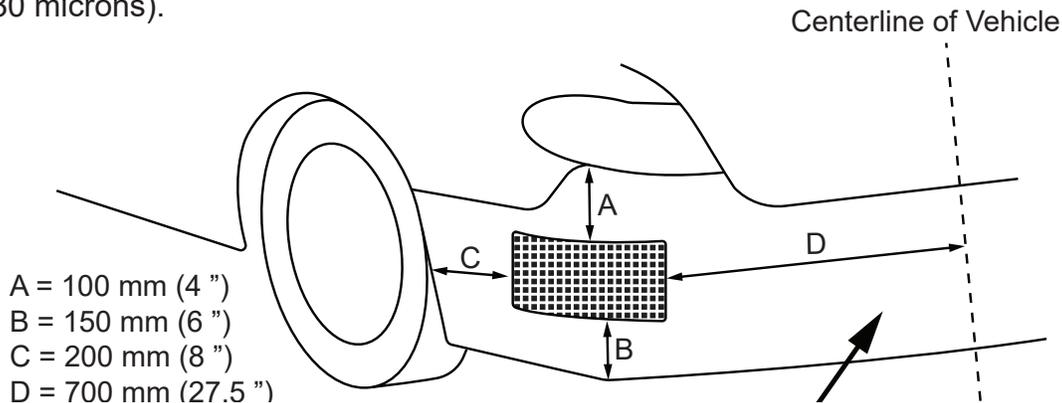
REAR CORNER RADAR MODULE (Left and Right)

Uses radar waves to determine the distance to objects in the vehicle's path of travel.

- Mounted using non-repairable metal bracket to the vehicle body structure behind the rear bumper cover.
- Metal bracket and radar modules are serviced separately.
- Input for lane keep assistance (LKA) and the blind spot warning (BSW) systems.
- 77 Ghz radar sensor.
- Medium range 0-160 meters (0-525 ft.).
- ADAS data is communicated over the ADAS CAN bus.
- Each module contains a 120-ohm terminating resistors for the private CAN bus.
- Left rear corner radar module is primary for communication over the ADAS CAN bus.
- Rear corner radar modules communicate with each other over a private CAN bus.
- Programming, coding, initialization and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Initialization required during module replacement.
- Calibrated using a static procedure.
- Receives supply voltage from the ignition switch.

Precautions for Rear Bumper Repair

- Body filler repairs are prohibited on either corner of the rear bumper cover in the shaded area shown in the image below.
- Paint repairs are permitted for minor damage that can be filled with primer and paint.
- Maximum primer and paint thickness on the bumper cover cannot exceed 13 mils (330 microns).



STEERING COLUMN MODULE

Analyzes inputs from steering wheel controls including the adaptive cruise control switches and the turn signal switch.

- ADAS data is communicated over the Vehicle CAN bus.
- Programming, coding, initialization and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Receives supply voltage from the battery and ignition switch.

SURROUND VIEW CAMERA (Right, Left, Front and Rear)

Captures and processes the images for use by the surround view system.

- Wide-angle (fish-eye lens) camera.
- Communicates with the surround view camera module over a high-speed video network using a coaxial cable.
- Programming, coding, initialization, calibration, and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Calibrated using a static procedure.
- Receives 6-volt supply from the surround view camera module.
- Side surround view camera:
 - Mounted directly to the appropriate side view mirror housing in an integral non-adjustable, non-repairable fixture.
 - Not serviceable separately from mirror housing.
- Front surround view camera mounted directly to the center of the front grille in an integral non-adjustable, non-repairable fixture.
- Rear surround view camera mounted directly to the rear deck lid in an integral non-adjustable, non-repairable fixture.

SURROUND VIEW CAMERA MODULE

Analyzes data from the surround view cameras to create a top-down, 360-degree composite view of the vehicle and its surroundings during parking and low speed operation.

- Uses input from the reverse lamp relay to activate the surround view and the back-up camera view.
- ADAS data is communicated over the ADAS CAN bus.
- Communicates with the surround view cameras over high speed video networks using coaxial cables.
- Programming, coding, initialization and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Receives supply voltage from the battery and switched voltage from the ignition switch.

TELEMATICS CONTROL MODULE

Analyzes data from the GPS antenna to use as an input for the ADAS.

- ADAS data is communicated over the ADAS CAN bus. Receives input from the GPS antenna module through a high-speed data network using a coaxial cable.
- Programming, coding, initialization and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Integrated cellular capabilities for data and voice transmission and reception.
- Receives supply voltage from the battery and switched voltage from the ignition switch. An internal serviceable backup battery provides emergency power.

TRANSMISSION CONTROL MODULE (TCM)

Controls transmission shifts as needed for the adaptive cruise control system and the electronic brake control systems.

- Input for the electronic brake control systems.
- ADAS data is communicated over the Vehicle CAN bus.
- Programming, coding, initialization and diagnostics performed through the 16 pin DLC using a PC-based scan tool.
- Receives supply voltage from the battery and switched voltage from the ignition switch.
- Module requires initialization during replacement.

ADAS-RELATED INPUTS

ACTIVE WHEEL SPEED SENSORS

Magneto-resistive sensors used to monitor wheel speed with vehicle moving forward or backwards.

- Two-wire sensor mounted in the wheel hub.
- Encoder is integral in the wheel bearing and hub assembly at each wheel.
- Is not serviceable separately from hub assembly.
- Input to the electronic brake control module.

ADAPTIVE CRUISE CONTROL SWITCH

Resistor divider network switch (momentary switch) used to control the adaptive cruise control system.

- Located on steering wheel.
- Input to the steering column module.

Adaptive Cruise Control Switch	Voltage at Steering Column Module Pin 21 when Switch Is Pressed
On/Off	0.2 V
Cancel	0.9 V
Distance +	1.7 V
Distance -	2.5 V
Coast/Set	3.2 V
Accel/Resume	4.0 V
No Action	4.8 V

ADAS CONTROL PANEL

Resistor divider network switch (momentary switch) used to turn ADAS functions ON or OFF.

- Located on dash, left side of instrument cluster.
- Input to the instrument cluster module.

ADAS Control Panel Switch	Voltage at Instrument Cluster ECM Pin 21 when Switch Is Pressed
Blind Spot Warning ON/OFF	0.2 V
Lane Keep Assistance ON/OFF	1.0 V
Automatic Emergency Braking ON/OFF	2.1 V
Cross Traffic Alert ON/OFF	3.0 V
Parking Collision Warning ON/OFF	3.9 V
No Action	4.8 V

BRAKE PEDAL POSITION SENSOR

Hall effect sensor used to measure brake pedal travel and speed (rate) of brake pedal application.

- Located on the brake pedal bracket.
- 5 V Supplied from pin 29 the EBC.
- Signal 1 -- 4.5 V = no brake pedal application.
- Signal 2 -- 0.5 V = no brake pedal application.
- Input to the EBC module.

BRAKE FLUID PRESSURE SENSOR

Three-wire analog sensor used to measure hydraulic pressure supplied from the brake master cylinder to the hydraulic electronic control unit.

- Threaded into the hydraulic electronic control unit.
- Signal -- 0.2 - 0.4 V = brakes not applied; 3.5 V = maximum brake hydraulic pressure.
- Input to the electronic brake control module.

ELECTRONIC POWER STEERING MOTOR POSITION SENSOR

Analog resolver sensor used to report electronic power steering motor position to the EPS module.

- Located inside the EPS module.
- Non-serviceable, integrated into the EPS module.
- Allows precise control of electronic power steering motor.

STEERING ANGLE SENSOR

Magneto-resistive position sensor used to measure steering wheel position (angle) and rate of turn (velocity).

- Smart sensor communicates data over the Vehicle CAN bus.
- Mounted to the upper steering column.
- Requires calibration with a scan tool after sensor replacement, steering column service, EPS module service, wheel alignment, loss of power/battery disconnect.
- Steering angle sensor calibration procedure:
 1. Connect scan tool to the 16 pin DLC.
 2. Ignition in Key ON/Engine RUNNING position.
 3. Select STEERING ANGLE SENSOR > Utility Function > Calibration.
 4. Rotate steering wheel to left lock and to right lock and recenter.
 5. With steering wheel centered, select Steering Angle Sensor Zero Calibration.
 6. Verify steering angle sensor angle reads 0° +/- 1.5°
 7. Select Confirm.
 8. Steering angle sensor calibration procedure results:
 - If steering angle sensor calibration = COMPLETE > scan, clear and retest for DTCs that may have set during ADAS service and calibration. If no DTCs are present, perform vehicle ADAS verification test drive
 - If steering angle sensor calibration = FAILED > review DTCs and diagnostic procedures.

STEERING SHAFT TORQUE SENSOR

Magneto-resistive torque sensor used to measure the amount of torque being applied to the steering wheel by the driver.

- Integral with the EPS module

STOP LAMP SWITCH

Momentary switch used to monitor brake pedal application.

- Mounted to the brake pedal bracket.
- Non-adjustable.
- Normally open (N.O.) switch that closes when the brake pedal is pressed/applied.
- Input to the ADAS central module.

TURN SIGNAL SWITCH

Combination switch used to activate the turn signals.

- Mounted to steering column.
- 2 positions for each direction:
 - ▣ Momentary activation of switch flashes turn signals 3 times.
 - ▣ Latching switch activates turn signal until canceled by steering wheel rotation or manually turned OFF.
- Input to the steering column module.

ULTRASONIC SENSORS

Ultrasonic transducers used to detect and calculate the distance to objects in proximity to the vehicle.

- 6 sensors located in each bumper (2 center, 2 mid, 2 corner).
- Center and mid sensors have a range of 0-2.5 meters (0-8 feet).
- Corner sensors have a range of 0-5.5 meters (0-18 feet).
- Corner sensors not interchangeable with center or mid sensors.
- Replacement sensors must be painted to match bumper cover.
- Maximum paint thickness = 6mil, 1 coat of base and 1 coat of clear.
- Input to the collision warning system (CWS) module.

ADAS-RELATED OUTPUTS

BLIND SPOT WARNING INDICATORS (Left and Right)

LED indicators provide visual alert when blind spot warning system is activated.

- Illuminates solid when a vehicle is in the blind spot (left or right).
- Flashes when the turn signal is activated and a vehicle is in the corresponding blind spot.
- Located in the side view mirror housings (left or right).
- Not serviceable separate of mirror housing.
- Controlled by corresponding rear radar module.

ELECTRONIC POWER STEERING MOTOR

Electronically controlled 3-phase electric motor integrated into the electronic power steering module.

- Non-serviceable.
- Provides driver with steering assistance.
- ADAS output for steering control.
- Controlled by the electronic power steering module.

MULTIFUNCTION FORWARD FACING CAMERA HEATER

Film-type heater used to prevent condensation from blocking multifunction forward facing camera view.

- Activated automatically at approximately 50° F (10° C) or less.
- Activated when front or rear defrost is activated.
- Mounted to the multifunction forward facing camera bracket.
- Controlled by the multifunction forward facing camera.
- Serviceable separate from the multifunction forward facing camera.

REVERSE LAMP RELAY

When energized, the relay provides battery voltage (B+) to the reverse lamps.

- Controlled by TCM.
- Input for surround view module to activate surround view display.
- Coil resistance specification is $36 \pm 4 \Omega$.
- Located in front fuse panel.

STEERING CONTROL SYSTEM

Through the vehicle networks the ADAS central module can request steering functions via the electronic power steering module.

STEERING WHEEL VIBRATION ACTUATOR

Haptic feedback motor that is private to the driver. Provides alert when the lane departure warning system is activated.

- Located in the steering wheel assembly.
- Controlled by the electronic power steering module.

STOP LAMP RELAY

When energized, the relay provides battery voltage (B+) to the stop lamps.

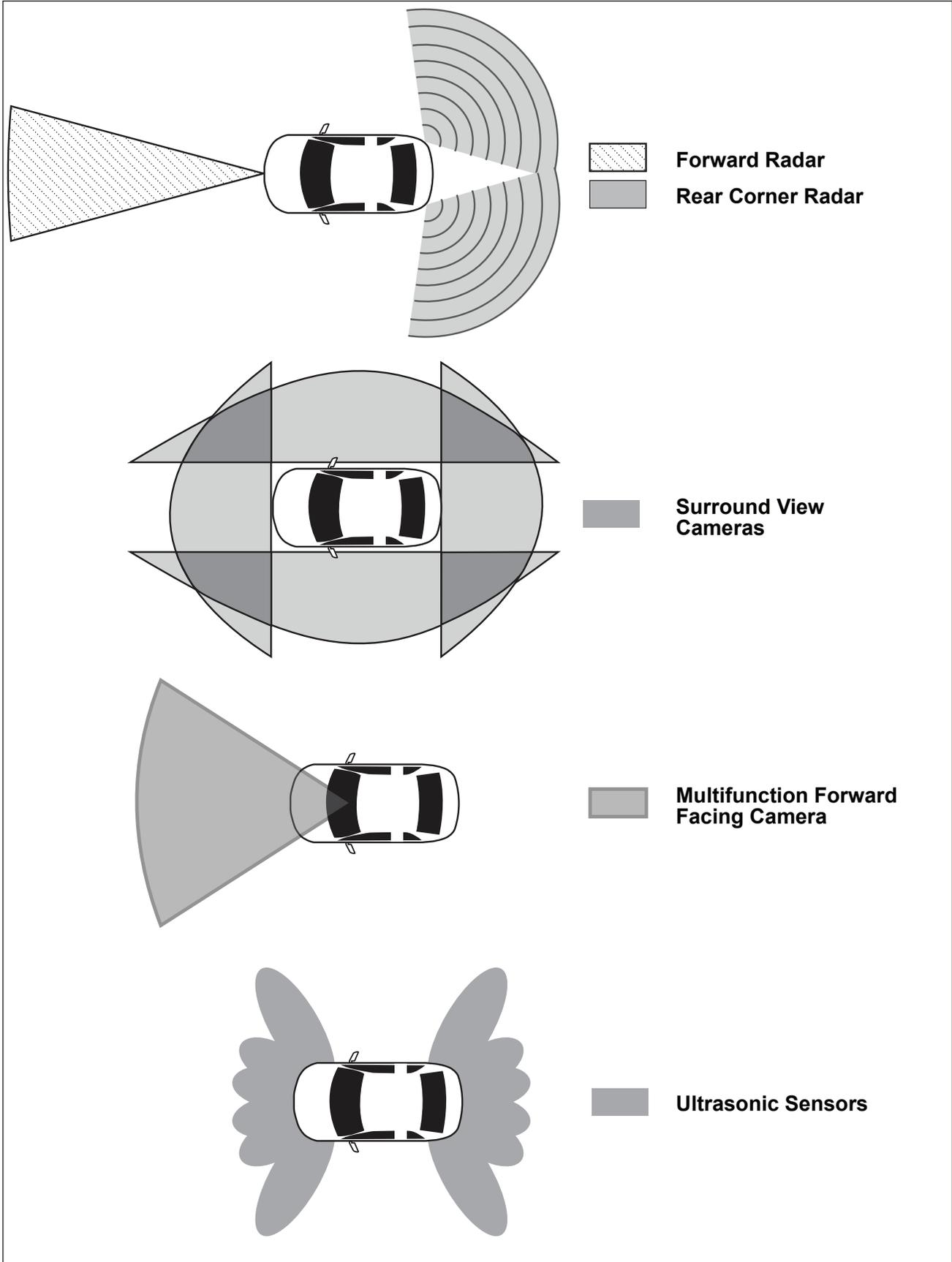
- Coil resistance specification is $36 \pm 4 \Omega$.
- Located in front fuse panel.
- Controlled by the ADAS central module and/or the stop lamp switch.

WARNING CHIME

Audible chime used as an alert when ADAS warning or mitigation are activated.

- Controlled by the ultrasonic module
- Located behind dash.
- Able to produce varying tones and frequency of tones.

ADAS DETECTION ZONES



ADVANCED DRIVER ASSISTANCE SYSTEM CALIBRATION

ADAS CALIBRATION VEHICLE PRECONDITIONS

- Wheel alignment within specifications.
- Ride height within specification.
- Tire pressures at specification.
- All fluids at correct levels.
- Fuel tank full.
- No loads in vehicle.
- Windshield clean.
- No objects hanging from rear view mirror.
- No objects on dash.

ENVIRONMENTAL PRECONDITIONS

• DYNAMIC CALIBRATION

- Clear weather conditions.
- Clear road lane markings.
- Flat road with minimal curves.
- Road conditions allowing vehicle speed 30 mph (48.3 km/h) – 65 mph (104.6 km/h).
- Moderate traffic on roadway.
- Fixed object on roadside (guard rails, light poles, trees, traffic controls).
- Driver and assistant to monitor scan tool, no passengers in rear seat of vehicle.

• STATIC CALIBRATIONS

All Static Calibrations

- Flat, level workshop floor -- 1° total floor slope maximum.
- No personnel in general calibration area.
- Wheels straight ahead (steering angle sensor reading 0° (+/- 1.5°)
- Hood and doors closed.
- Battery voltage maintained above 12.6 volts.

Multipurpose and Surround View Cameras Calibrations

- Bright, even shop lighting.
- No windows or open doors in backgrounds of calibration targets.
- No contrasting/conflicting objects within or beyond calibration target area.
- All exterior vehicle lights OFF.

RADAR Calibrations

- No radar reflective objects located within 6 m (20 ft) x 6 m (20 ft) x 3 m (10 ft) of the vehicle.

Required Shop Facility Area (Unobstructed)

- 14 m (45 ft) length by 9 m (30 ft) wide. Ceiling height 5 m (15 feet) minimum.

Mandatory Tools Required

- PC-based scan tool with OEM software
- Calibration Targets
 - Radar calibration fixture with radar reflector (2)
 - Multifunction forward facing camera target fixture with targets 1, 2 and 3
 - Surround view calibration mats 1 and 2
- Metric tape measure
- Inclinator
- Laser level
- Plumb bob and string
- Extra string
- Masking tape
- Marking pen / marker
- Chalk
- Battery maintainer

ADAS RELATED CALIBRATION REQUIREMENTS

	Forward Radar Module	Multifunction Forward Facing Camera Module	Rear Corner Radar Modules	Surround View Camera Modules	Steering Angle Sensor
After removal, replacement, or reprogramming of a module and/or a sensor	✓	✓	✓	✓	✓
After windshield removal or replacement		✓			
After suspension or steering service	✓	✓	✓		✓
After wheel alignment	✓	✓			✓
After collision or structural damage	✓	✓	✓	✓	✓
After SRS air bag deployment	✓	✓		✓	✓
When directed by a DTC	✓	✓	✓	✓	✓
When a malfunction is suspected	✓	✓	✓	✓	✓
After front bumper removal or replacement	✓				

checkmark (✓) = required

FORWARD RADAR CALIBRATION

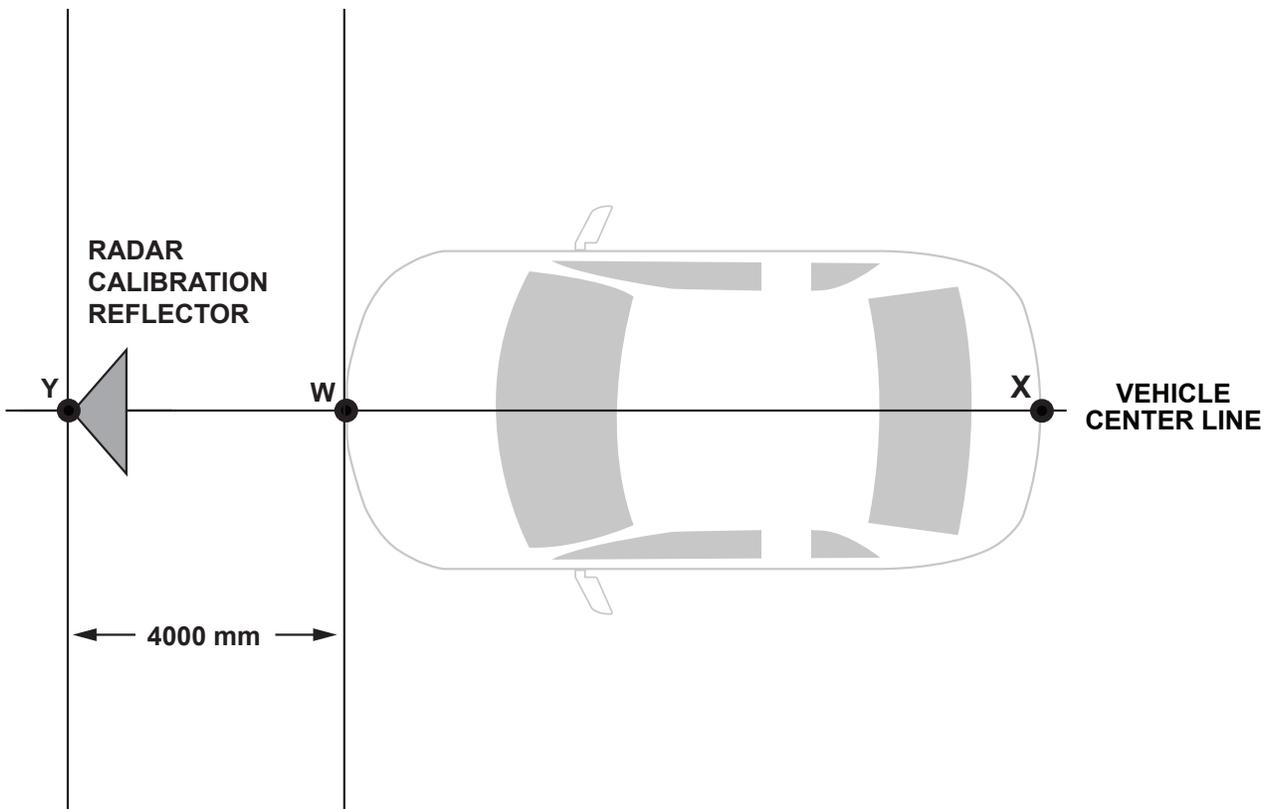
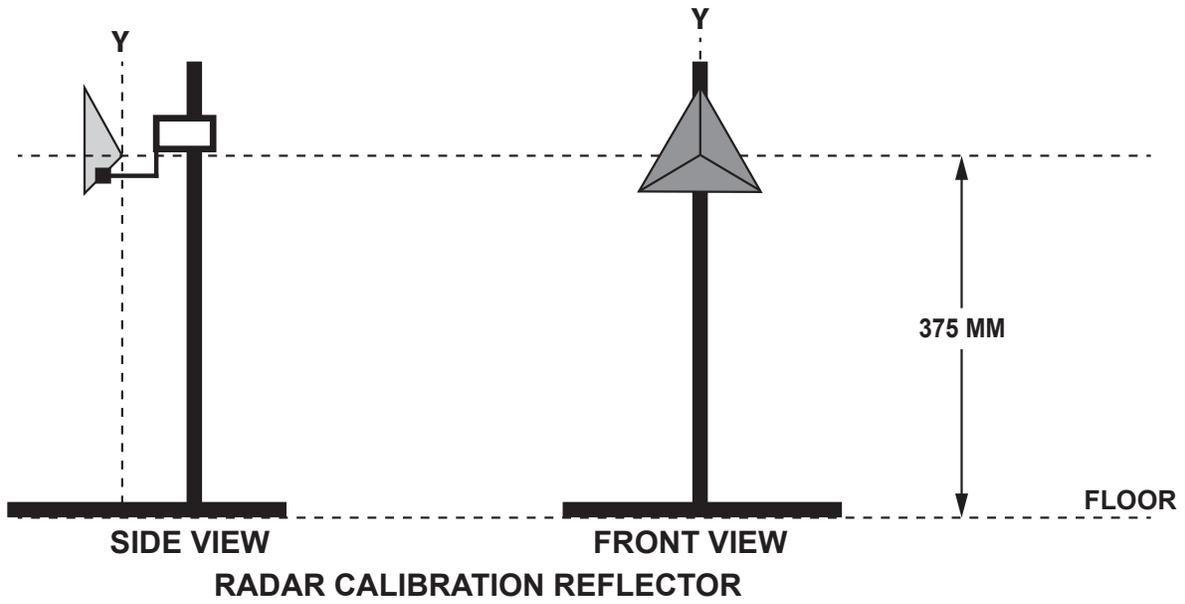
BASE MECHANICAL ADJUSTMENT (must be performed before static calibration)

1. Verify ADAS CALIBRATIONS VEHICLE PRECONDITIONS and STATIC PRECONDITIONS have been met.
2. Access forward radar module to perform the base mechanical adjustments.
3. Place instrument (bubble level or inclinometer) horizontally on the flat top surface of the forward radar module and note level measurement:
 - a. If measurement of $0.0^{\circ} \pm 1.0^{\circ}$ is indicated, proceed to step 4.
 - b. If measurement is outside of specification, adjust upper left screw to bring radar module into level position.
4. Place instrument (bubble level or inclinometer) vertically on the flat front surface of the forward radar module and note plumb measurement:
 - a. If measurement of $0.0^{\circ} \pm 1.0^{\circ}$ is indicated, proceed to step 5.
 - b. If measurement is outside of specification, adjust lower right screw to bring radar module into level position.
5. Reverify horizontal level and vertical plumb of forward radar module. Readjust as necessary. When both adjustments are within specification, move to static calibration procedure.

STATIC CALIBRATION PROCEDURE

1. Find and mark the vehicle's centerline:
 - a. Using a plumb bob and the front vehicle emblem as reference, mark the center of the front of vehicle on shop floor for point W.
 - b. Using a plumb bob and the rear vehicle emblem as reference, mark the center of the rear of vehicle on floor for point X.
 - c. Using a string, connect point W with point X, extending a minimum of 5000 mm past point X. This is the centerline of the vehicle.
2. Determine location of the radar calibration reflector.
 - a. Measure 4000 mm forward from point W along the vehicle centerline and mark point Y.
 - b. Place radar calibration reflector centered on top of point Y, with rear point of the reflector 375 mm from the shop floor.
3. Connect scan tool to the 16 pin DLC.
4. Place ignition in Key ON/Engine OFF position.
5. Select *Forward Radar > Utility Function > Static Calibration*.
 - a. Select *Radar Aiming Calibration > Forward Radar Module > Horizontal Adjustment*.
 - b. Adjust the upper left adjustment screw on forward radar module bracket until HORIZONTAL ANGLE displays $0.00^{\circ} \pm 0.25^{\circ}$. Adjust the lower right adjustment screw on forward radar module bracket until VERTICAL ANGLE displays $0.00^{\circ} \pm 0.25^{\circ}$:
 - i. If specification is achieved, select COMPLETE. Use scan tool to check for DTCs that may have set during ADAS service and calibration. Clear DTCs. If no DTCs are present, perform vehicle DYNAMIC CALIBRATION PROCEDURE.
 - ii. If specification is not able to be achieved, or a TARGET NOT FOUND message is displayed, use scan tool to review failure codes and/or perform appropriate diagnostic procedures. Repeat calibration procedures as required.

FORWARD RADAR STATIC CALIBRATION



MULTIFUNCTION FORWARD FACING CAMERA CALIBRATION

STATIC CALIBRATION PROCEDURE

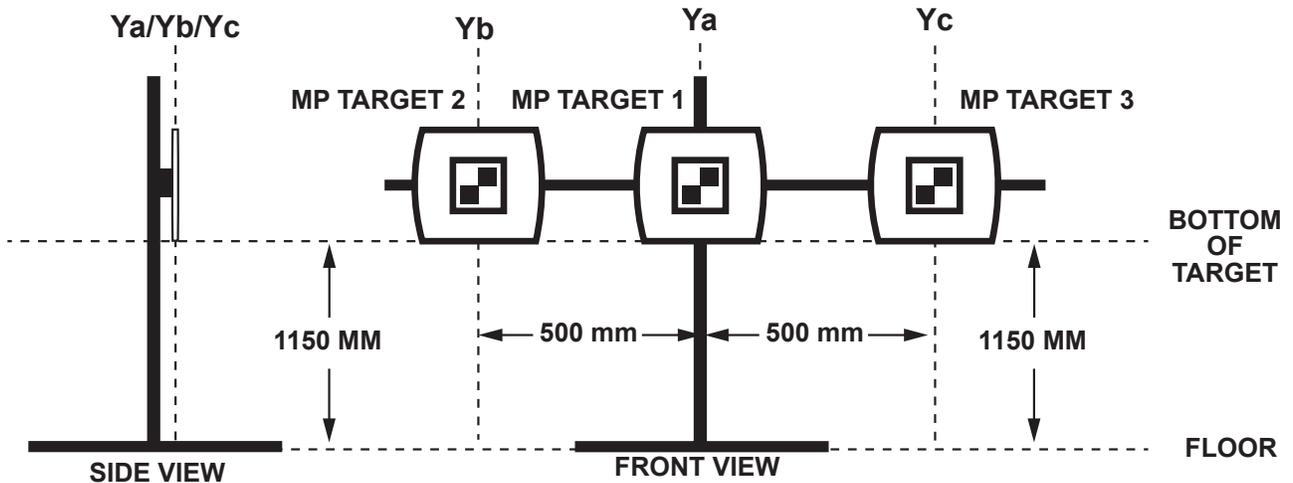
1. Verify ADAS CALIBRATIONS VEHICLE PRECONDITIONS and STATIC PRECONDITIONS have been met.
2. Find and mark the vehicle's centerline:
 - a. Using a plumb bob and the front vehicle emblem as reference, mark the center of the front of vehicle on shop floor for point W.
 - b. Using a plumb bob and the rear vehicle emblem as reference, mark the center of the rear of vehicle on floor for point X.
 - c. Using a string, connect point W with point X and extending a minimum of 5000 mm past point X. This is the centerline of the vehicle.
3. Determine location of multifunction forward facing camera target #1:
 - a: Measure 2000 mm forward from point W along the vehicle centerline and mark point Ya.
 - b. Place multipurpose forward facing camera target #1 centered on top of point Ya, with BOTTOM of target 1150 mm from the shop floor.
 - c. Using a bubble level, verify true horizontal and vertical alignment of the target.
4. Determine location of multifunction forward facing camera target #2:
 - a: From point Ya, mark a 90 ° perpendicular (right angle) line to the vehicle's centerline and extended at least 600 mm to each side.
 - b. Measure 500 mm horizontal and to the right from point Ya, and mark point Yb.
 - c. Place multifunction forward facing camera target #2 centered on top of point Yb, with BOTTOM of target 1150 mm from the shop floor.
 - d. Using a bubble level, verify true horizontal and vertical alignment of the target.
5. Determine location of multifunction forward facing camera target #3:
 - a. Measure 500 mm horizontal and to the left from point Ya and mark point Yc.
 - b. Place multifunction forward facing camera target #3 centered on top of point Yc with BOTTOM of target 1150 mm from the shop floor.
 - c. Using a bubble level, verify true horizontal and vertical alignment of the target.
6. Connect scan tool to the 16 pin DLC.
7. Place ignition in Key ON/Engine OFF position.
8. Select the *MULTIFUNCTION FORWARD FACING CAMERA MODULE > Utility Function > Static Calibration*.
9. For appropriate target (#1, #2, or #3), select *Multifunction Forward Facing Camera Aiming > Target #X*. For each target, allow process to run until COMPLETE is displayed.
10. Select CALIBRATION RESULTS:
 - a. If scan tool indicates CALIBRATION COMPLETE for all three targets, proceed to DYNAMIC procedure.
 - b. If scan tool indicates CALIBRATION FAILED for any of the three targets, use scan tool to review failure codes and perform appropriate diagnostic procedures. Repeat calibration procedures as required.

DYNAMIC CALIBRATION PROCEDURE

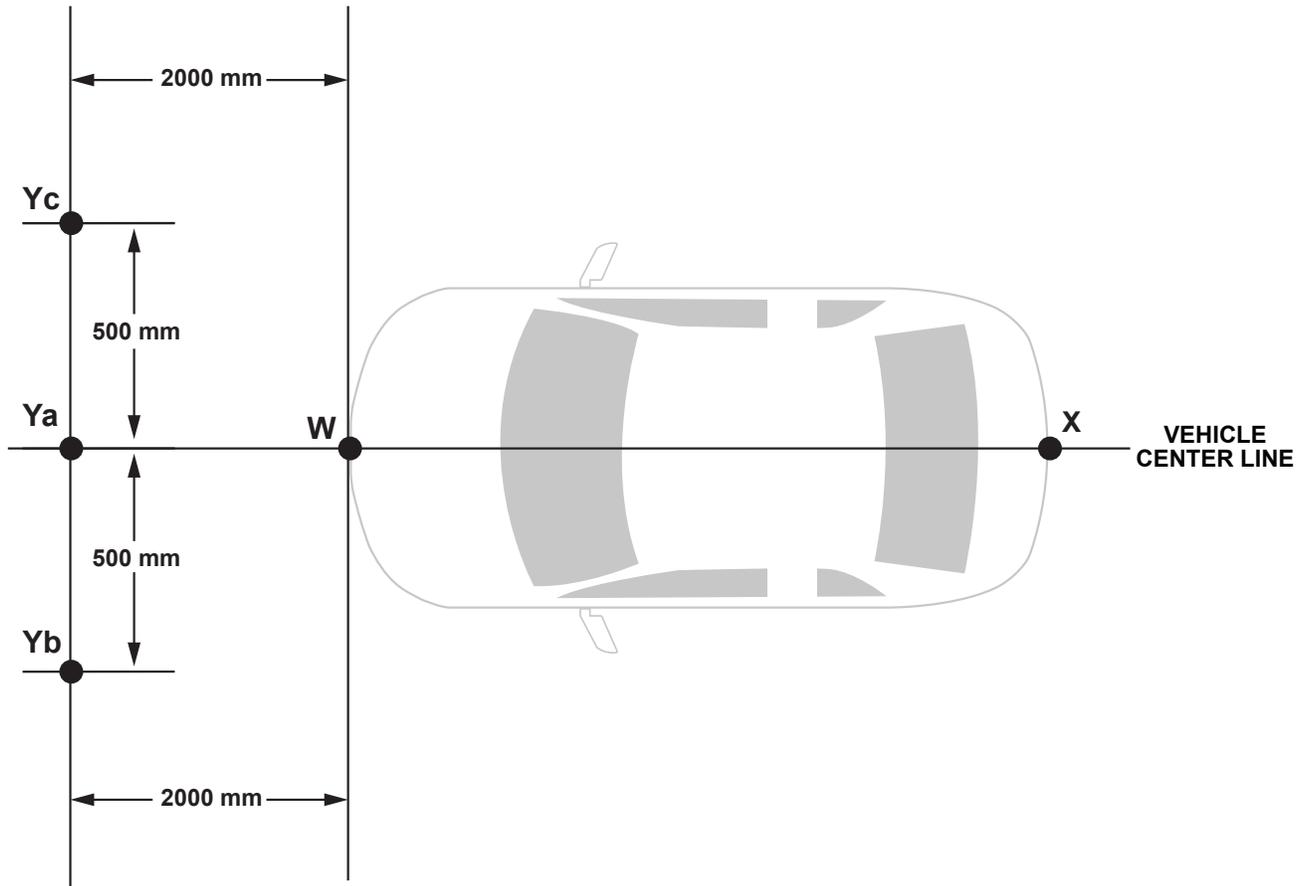
1. Verify ADAS CALIBRATIONS VEHICLE PRECONDITIONS and DYNAMIC PRECONDITIONS have been met.
2. Place ignition in Key ON/Engine OFF position.
3. Connect scan tool to the 16 pin DLC.

4. Select the *MULTIFUNCTION FORWARD FACING CAMERA MODULE > Utility Function > Dynamic Calibration*.
5. Select *Dynamic Calibration Drive Cycle* and follow these steps:
 - a. Start engine.
 - b. Drive vehicle at speed between 35 – 65 mph (22.7 and 104.6 km/h).
 - c. Minimize lane changes.
 - d. Drive the vehicle until the scan tool indicates CALIBRATION COMPLETE.
6. Select CALIBRATION RESULTS:
 - a. If scan tool indicates CALIBRATION COMPLETE, use scan tool to check for DTCs that may have set during ADAS service and calibration. Clear any DTCs. Perform vehicle ADAS VERIFICATION TEST DRIVE.
 - b. If scan tool indicates CALIBRATION FAILED, use scan tool to review failure codes and perform appropriate diagnostic procedures. Repeat calibration procedures as required.

MULTIFUNCTION FORWARD FACING CAMERA STATIC CALIBRATION



MULTIFUNCTION FORWARD FACING CAMERA TARGET FIXTURE



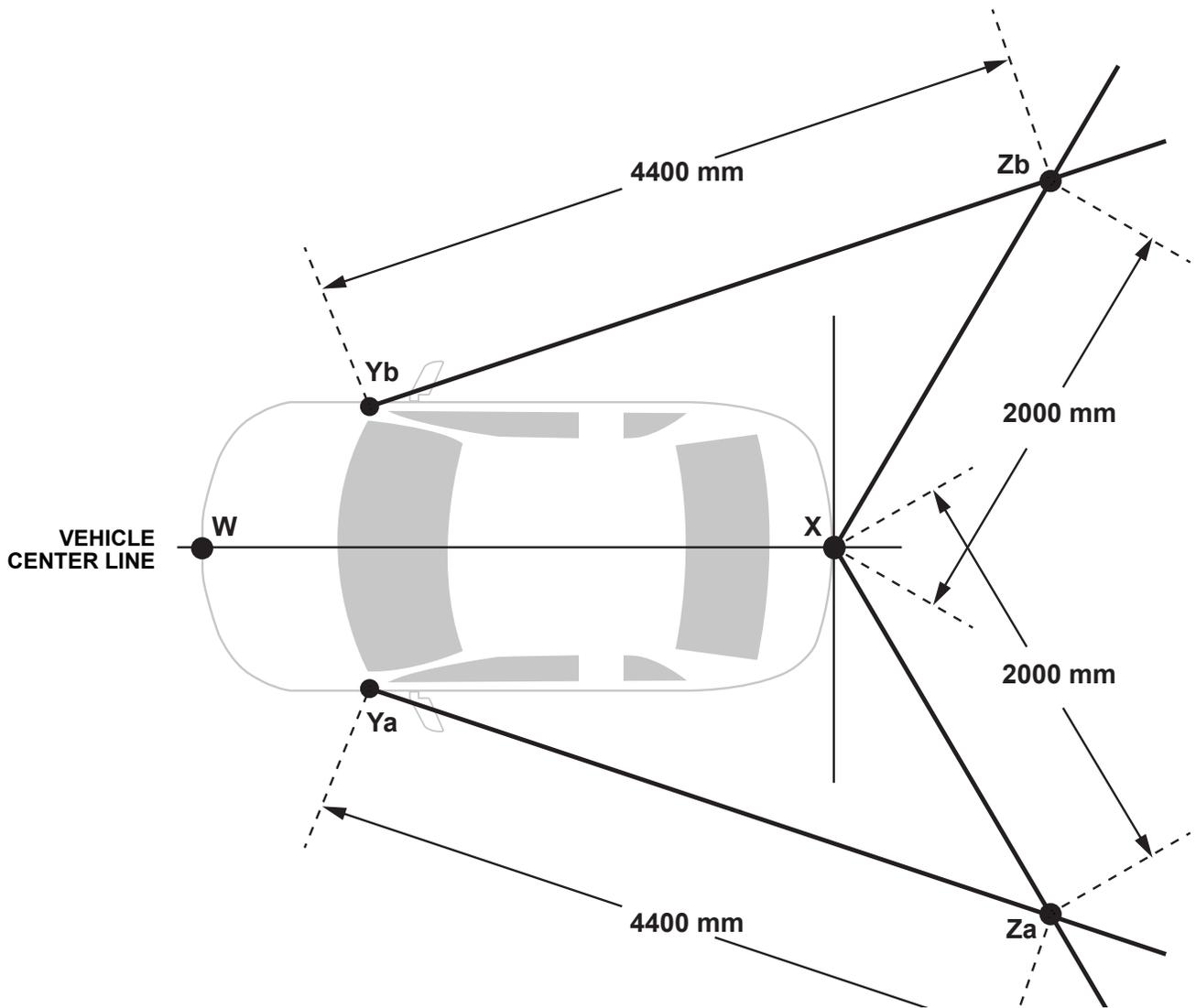
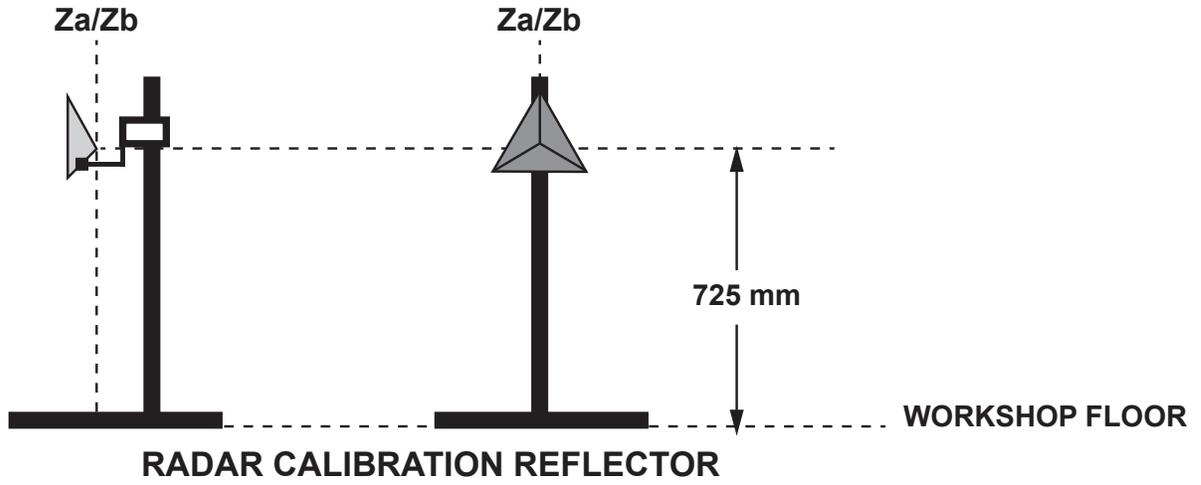
REAR CORNER RADAR CALIBRATION

Static Calibration Procedure

NOTE: The left- and right-side calibrations do not have to be performed at the same time. Either side may be calibrated individually.

1. Verify ADAS CALIBRATIONS VEHICLE PRECONDITIONS and STATIC PRECONDITIONS have been met.
2. Find and mark the vehicle's centerline.
 - a. Using a plumb bob and the front vehicle emblem as reference, mark the center of the front of vehicle on shop floor for point W.
 - b. Using a plumb bob and the rear vehicle emblem as reference, mark the center of the rear of vehicle on floor for point X.
 - c. Using a string, connect point W with point X, extending a minimum of 5000 mm past point X. This is the centerline of the vehicle.
3. Determine location of radar reflector on LEFT side of vehicle:
 - a. Locate service plug along left frame rail behind the left front wheel well.
 - b. Drop a plumb bob from the service plug and on the shop floor place a mark for point Ya.
 - c. Using a 4400 mm string radiating from point Ya and another 2000 mm string radiating from point X, place a mark on the shop floor at the intersection of the 2 strings. This is point Za.
 - d. Place a radar calibration reflector at point Za.
4. Determine location of radar calibration reflector on RIGHT side of vehicle:
 - a. Locate service plug along right frame rail behind the right front wheel well.
 - b. Drop a plumb bob from the service plug and on the shop floor mark point Yb.
 - c. Using a 4400 mm string radiating from point Y and another 2000 mm string radiating from point X, place a mark on the shop floor at the intersection of the 2 strings. This is point Zb.
 - d. Place a radar calibration reflector at point Zb.
5. Connect scan tool to the 16 pin DLC.
6. Place ignition in Key ON/Engine OFF position.
7. Select the *Rear Corner Radar > Utility Function > Static Calibration*.
8. Select *Corner Radar Calibration* for the appropriate side (left or right).
9. When scan tool indicates CALIBRATION COMPLETE, select CALIBRATION RESULTS for the appropriate side (left or right):
 - a. If a reading between -2.5° and $+2.5^{\circ}$ is indicated, the calibration is within specification. Use scan tool to check for DTCs that may have set during ADAS service and calibration. Clear any DTCs. Perform vehicle ADAS VERIFICATION TEST DRIVE.
 - b. If a reading not between -2.5° and $+2.5^{\circ}$ is indicated for either side (left or right), use scan tool to review failure codes and perform appropriate diagnostic procedures. Repeat calibration procedures as required.

REAR CORNER RADAR STATIC CALIBRATION

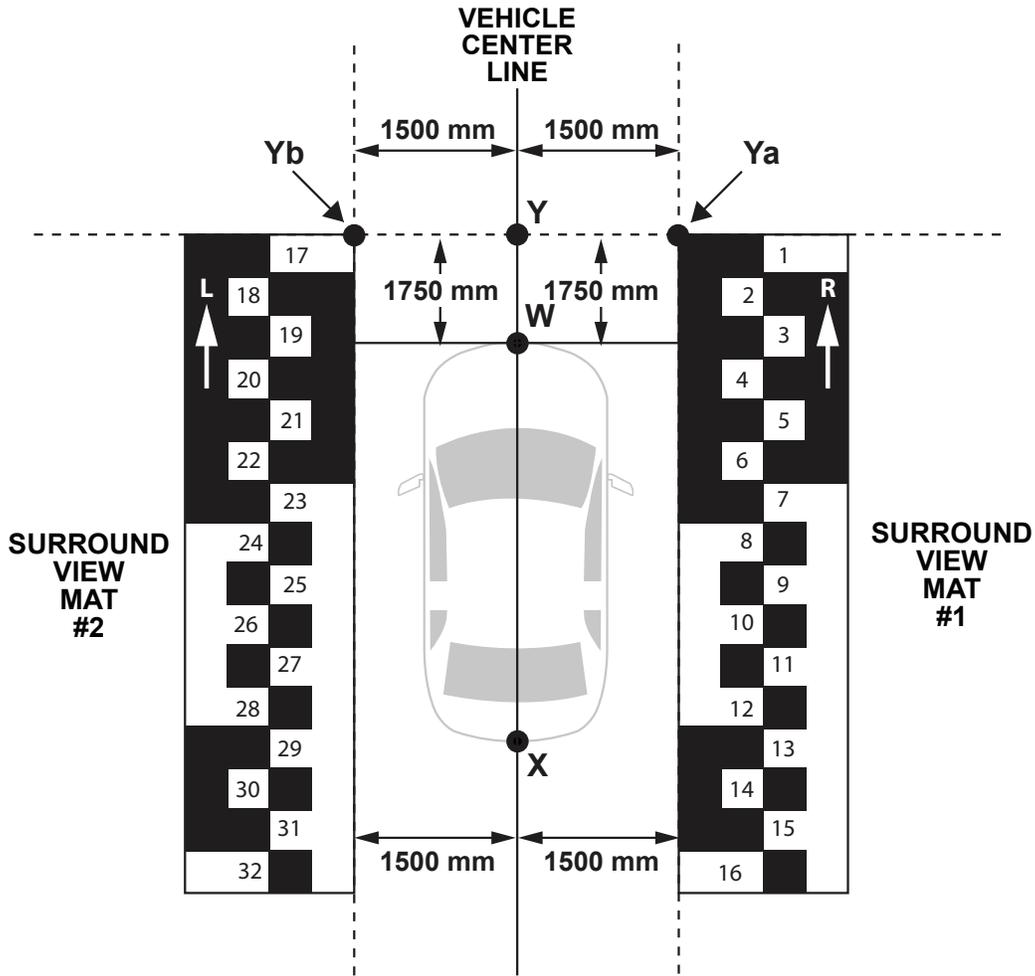


SURROUND VIEW SYSTEM CALIBRATION

STATIC CALIBRATION PROCEDURE

1. Verify ADAS CALIBRATIONS VEHICLE PRECONDITIONS and STATIC PRECONDITIONS have been met.
2. Find and mark the vehicle's centerline:
 - a. Using a plumb bob and the front vehicle emblem as reference, mark the center of the front of vehicle on shop floor for point W.
 - b. Using a plum bob and the rear vehicle emblem as reference, mark the center of the rear of vehicle on floor for point X.
 - c. Using a string, connect point W with point X, extending a minimum of 2000 mm past points W and X. This is the centerline of the vehicle.
3. Determine location of surround view calibration mats #1 and #2.
 - a. Along the vehicle centerline, measure 1750 mm forward from point W and place a mark on shop floor for point Y.
 - b. Using a string, stretch a line perpendicular to the vehicle centerline from point Y outwards toward the passenger side. At 1500 mm, on the shop floor mark point Ya.
 - c. Place the front inward corner of surround view calibration mat #1 at point Ya.
 - d. Using a string, stretch a line perpendicular to the vehicle centerline from point Y outwards toward the driver side. At 1500 mm, on the shop floor mark point Yb.
 - e. Place the front inward corner of surround view calibration mat #2 at point Yb.
4. Connect scan tool to the 16 pin DLC.
5. Place ignition in Key ON/Engine OFF position.
6. Select the *Surround View System Module > Utility Function > Static Calibration*.
7. Select *Surround View Camera Aiming*.
8. Follow instructions on scan tool to:
 - a. Align RF crosspoint with intersection of boxes 2/3 on mat 1.
 - b. Align LF crosspoint with intersection of boxes 18/19 on mat 2.
 - c. Align RR crosspoint with intersection of boxes 14/15 on mat 1.
 - d. Align LR crosspoint with intersection of boxes 30/31 on mat 2.
9. When completed with adjustments:
 - a. If able to adjust all cameras to appropriate position, select CONTINUE. Use scan tool to check for DTCs that may have set during ADAS service and calibration. Clear DTCs. If no DTCs are present, perform vehicle ADAS VERIFICATION TEST DRIVE.
 - b. If unable to adjust all cameras to appropriate position, select CONTINUE. Use scan tool to review failure codes and/or perform appropriate diagnostic procedures.

SURROUND VIEW STATIC CALIBRATION



FORWARD

LEFT

RIGHT

REARWARD

FORWARD

LEFT

RIGHT

REARWARD

FORWARD

LEFT

RIGHT

REARWARD

FORWARD

LEFT

RIGHT

REARWARD

CONTINUE

SCAN TOOL DISPLAY

Use these scan tool buttons

FORWARD

LEFT

RIGHT

REARWARD

to adjust each crosspoint

to meet the corresponding target.

When complete, press

CONTINUE

ADAS VERIFICATION TEST DRIVE

Conducted by shop personnel after any ADAS related repair to verify all ADAS related malfunction indicators are not illuminated and the ADAS system is functioning as designed. The ADAS verification test drive is a separate operation from any road test performed during ADAS calibration procedures.

1. Verify ADAS CALIBRATIONS VEHICLE PRECONDITIONS and STATIC PRECONDITIONS have been met.
2. Disconnect the scan tool (if connected).
3. Test drive the vehicle and verify the proper operation of the following systems:
 - a. Adaptive cruise control
 - b. Blind spot warning
 - c. Rear cross traffic warning
 - d. Lane keep assistance
 - e. Surround view system
4. Test drive the vehicle and verify there is no unwarranted application of the following systems:
 - a. Parking collision warning
 - b. Forward collision warning
 - c. Automatic emergency braking
5. During the test drive(s) verify no ADAS malfunction indicators are illuminated.
6. After the appropriate test drive(s) is complete:
 - a. Perform an all-systems scan of the vehicle.
 - a. Verify no ADAS-related DTCs are stored in any module

DATA COMMUNICATIONS

CAN BUS NETWORKS

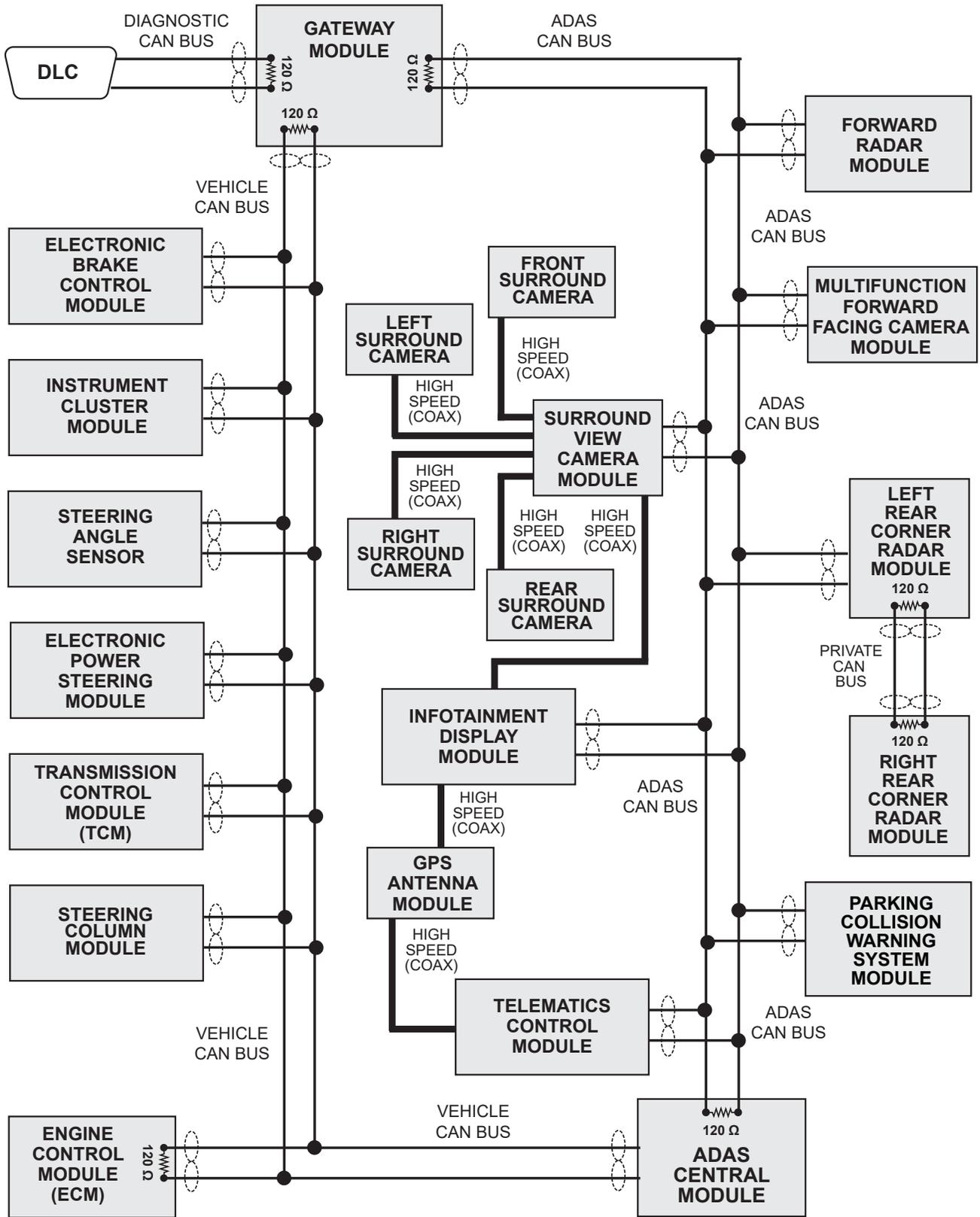
High-speed, serial data bus.

- Two-wire twisted pair communications network.
- Data-high circuit switches between 2.5 (rest state) and 3.5 volts (active state).
- Data-low circuit switches between 2.5 (rest state) and 1.5 volts (active state).
- Any of the following conditions will cause the CAN bus communications to fail and result in the storage of network DTCs and many systems default to a failure state:
 - either data line shorted to voltage.
 - either data line shorted to ground.
 - one data line shorted to the other data line.
 - an open in either data line to a module.
 - internal fault inside a network module.
- Each CAN bus network includes two 120-ohm terminating resistors each located integral in a network module.
 - The CAN bus remains operational when one of the two modules containing a terminating resistor is not connected to the network. DTCs will set and some ADAS will default to failure mode.
 - The CAN bus will fail when both terminating resistors are not connected to the network and all ADAS functions will default to failure mode.
- If the ADAS CAN bus fails, the ADAS central control module can communicate with other modules over a back-up/redundant CAN bus to control limited ADAS functions.

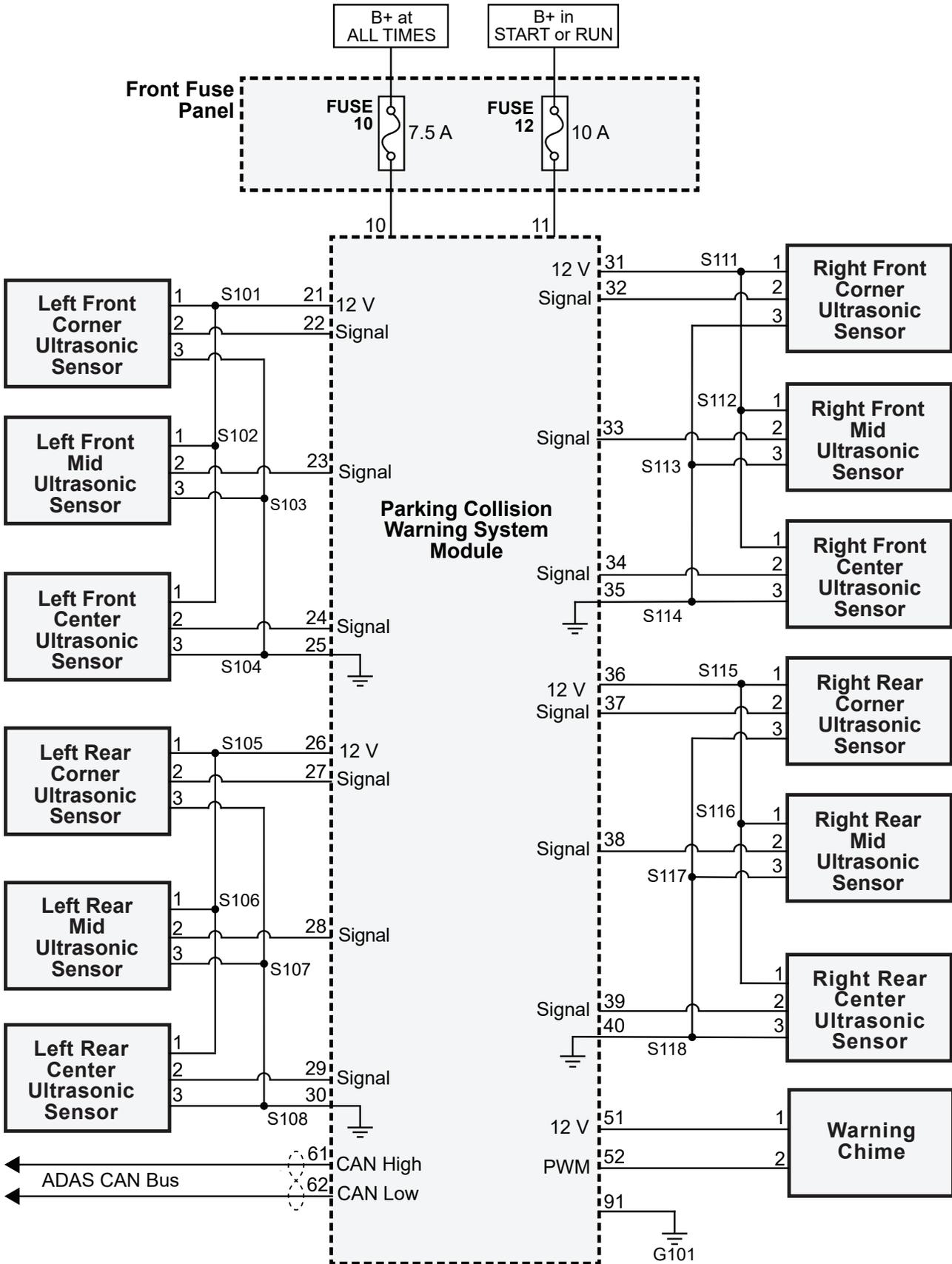
HIGH SPEED BUS NETWORKS

- High speed.
- Uses coaxial (COAX) cable.
- Any of the following conditions **may** cause the high speed bus communications to fail or result in poor image quality:
 - data line shorted to voltage.
 - data line shorted to ground.
 - an open data line.
 - damaged cable shielding.
 - internal fault inside a network module.
- Errors in the high speed bus **will not** cause DTCs to set.

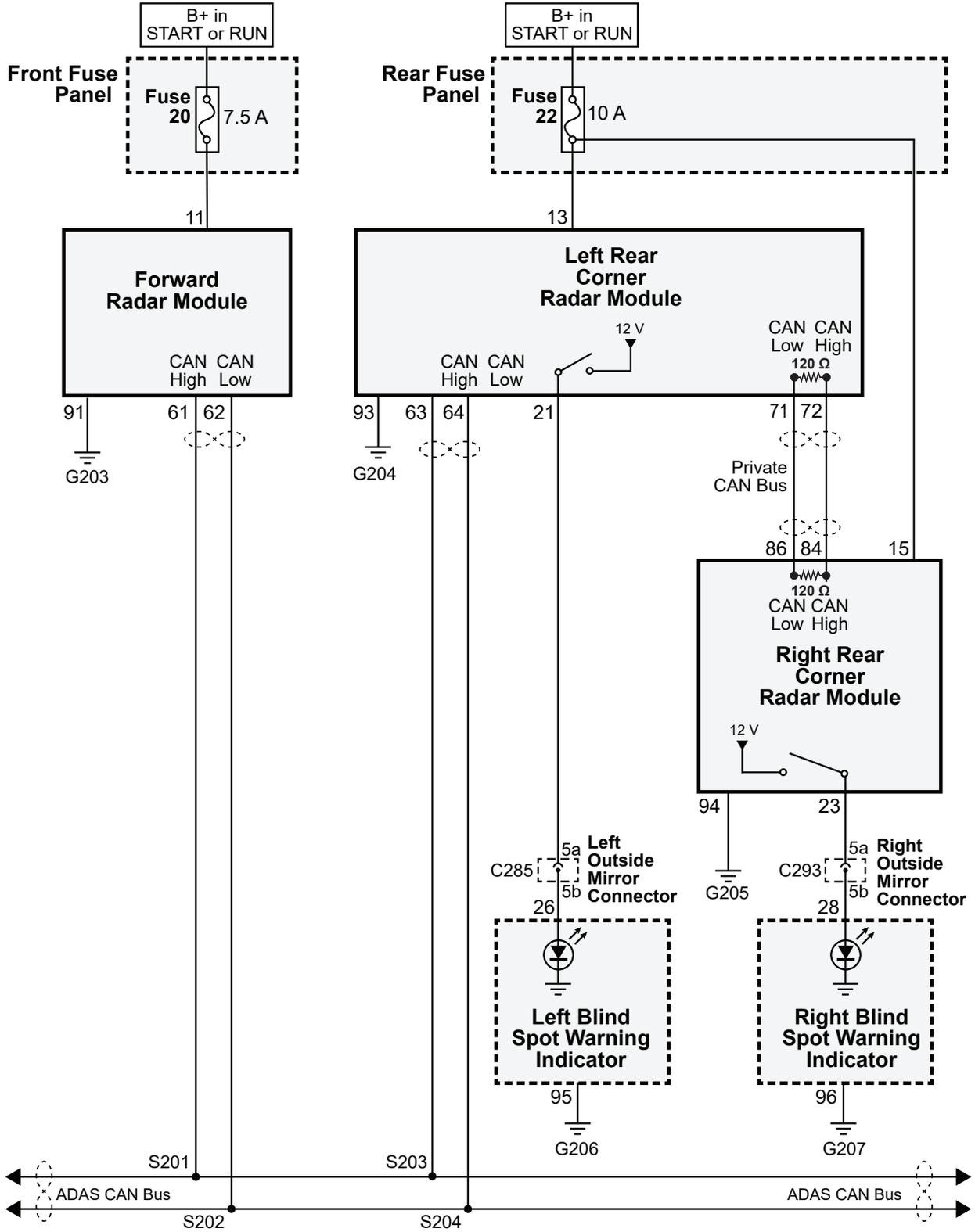
NETWORK TOPOGRAPHY



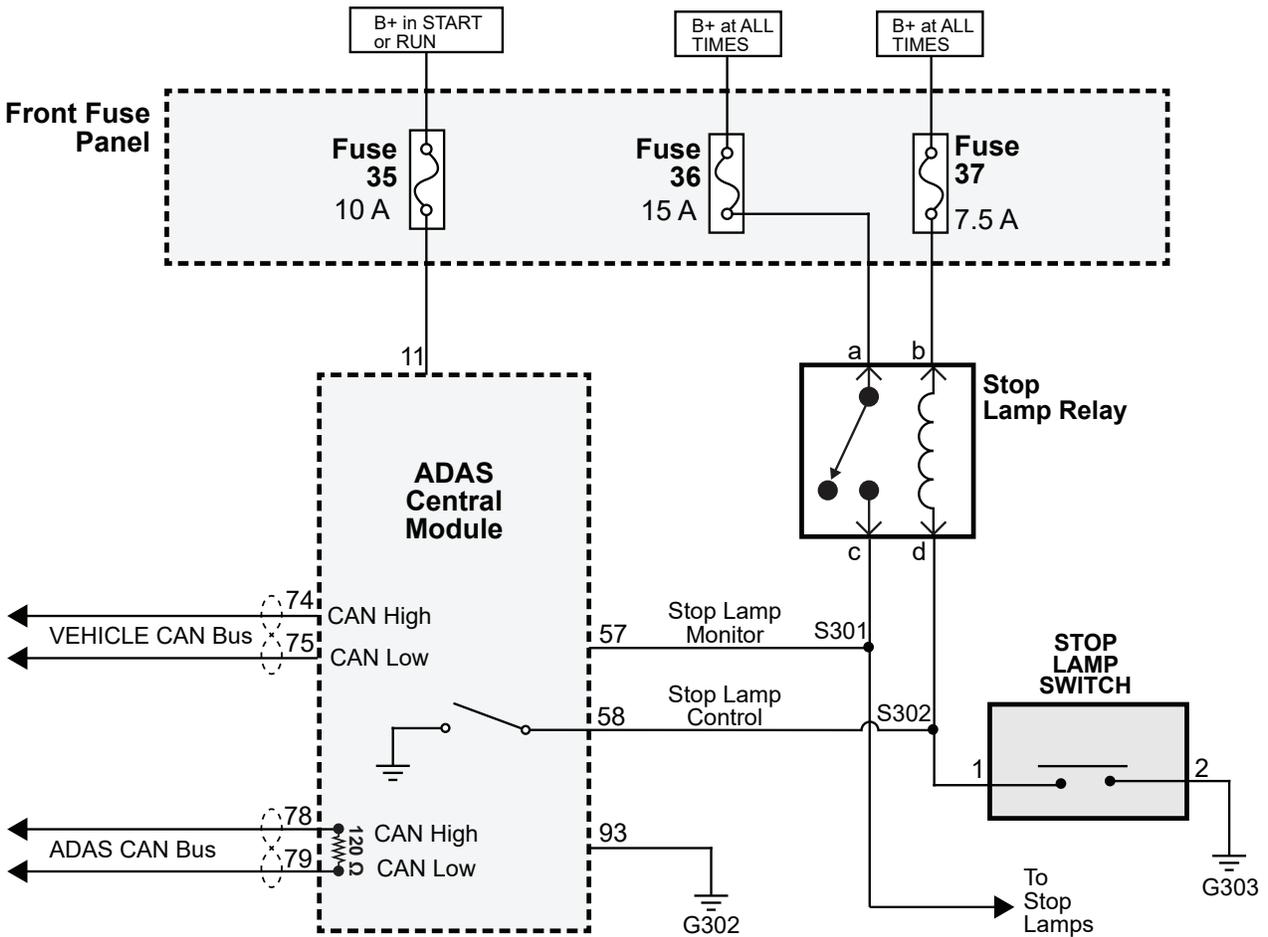
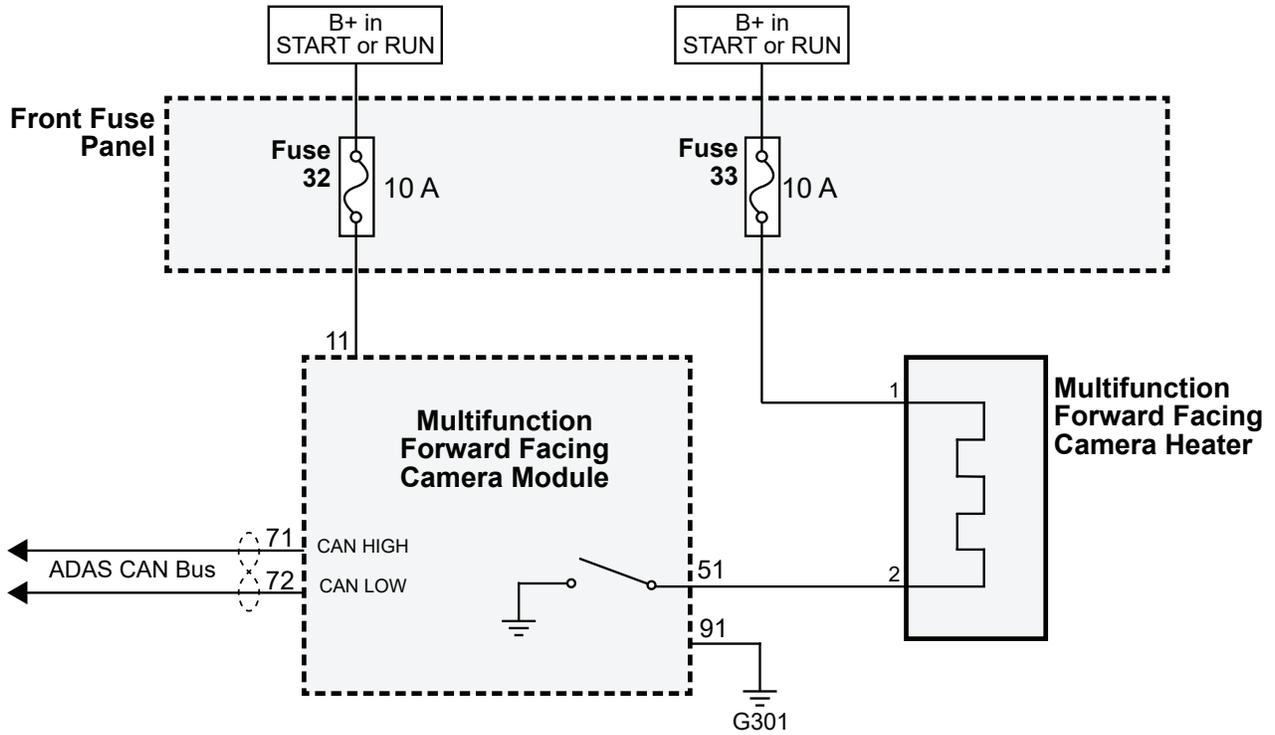
Parking Collision Warning (PCW) System

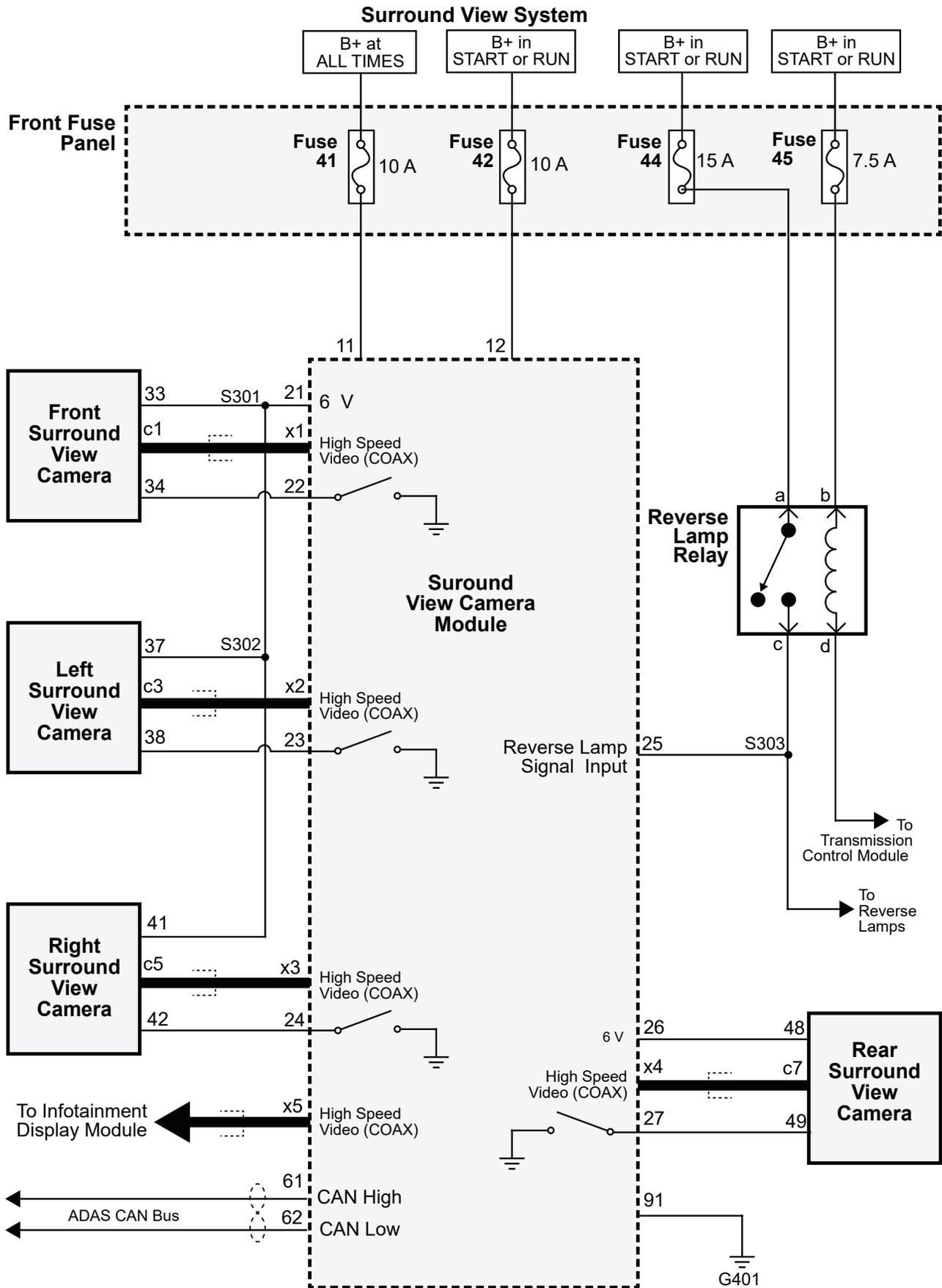


Radar Modules / Blind Spot Warning Indicators

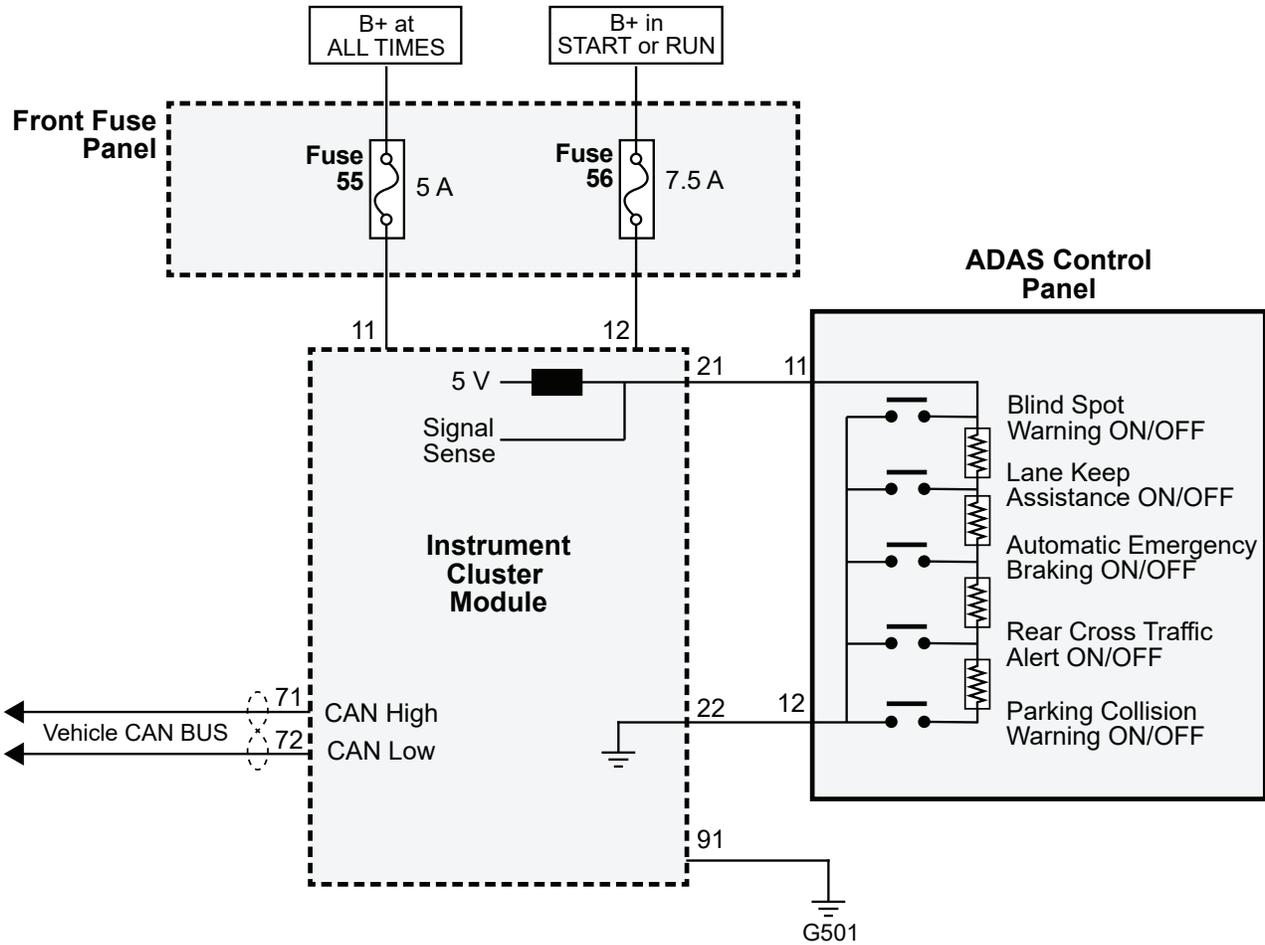


Multifunction Forward Facing Camera / ADAS Central Module / Stop Lamp Controls

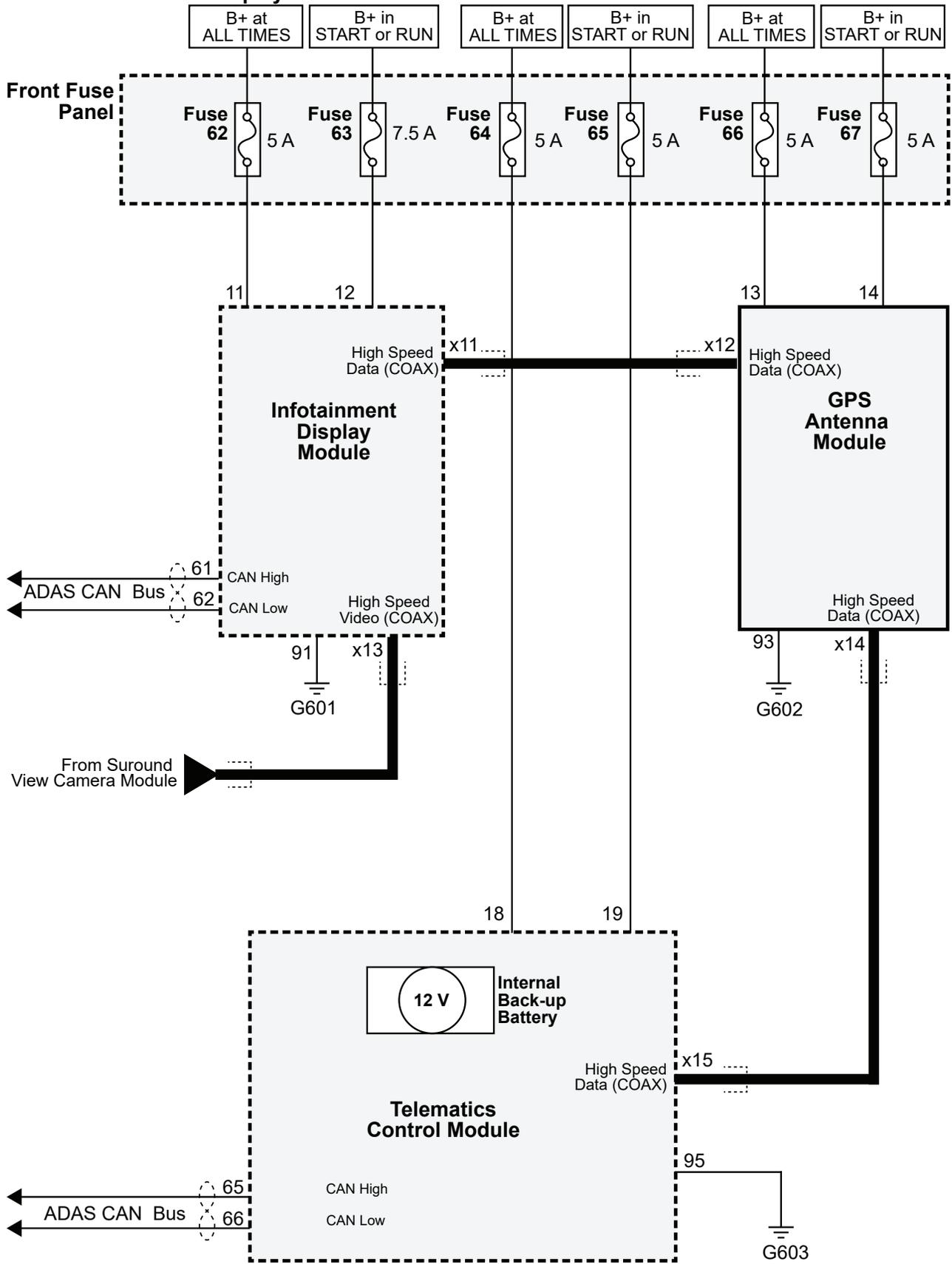




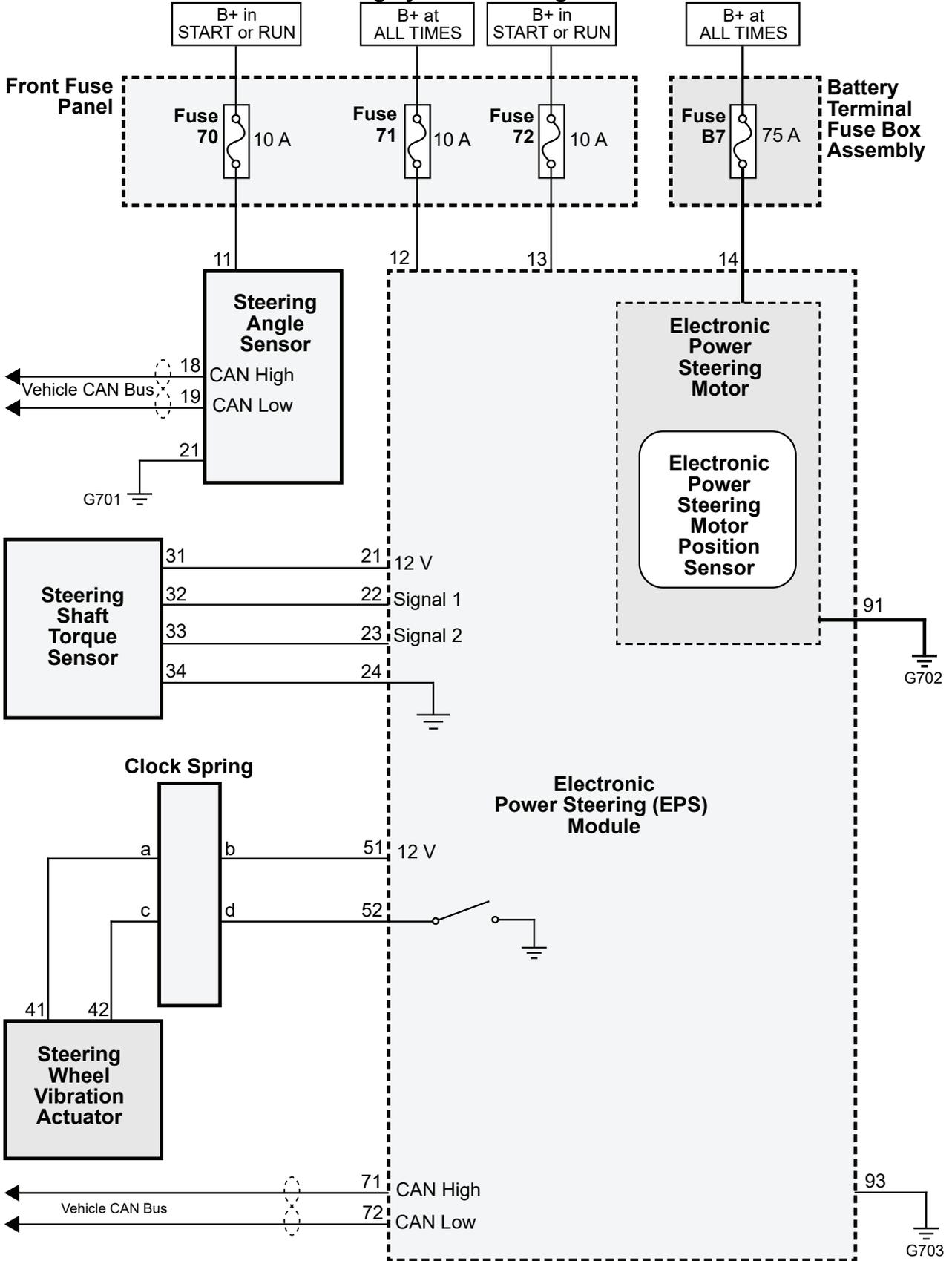
Instrument Cluster Module / ADAS Control Panel



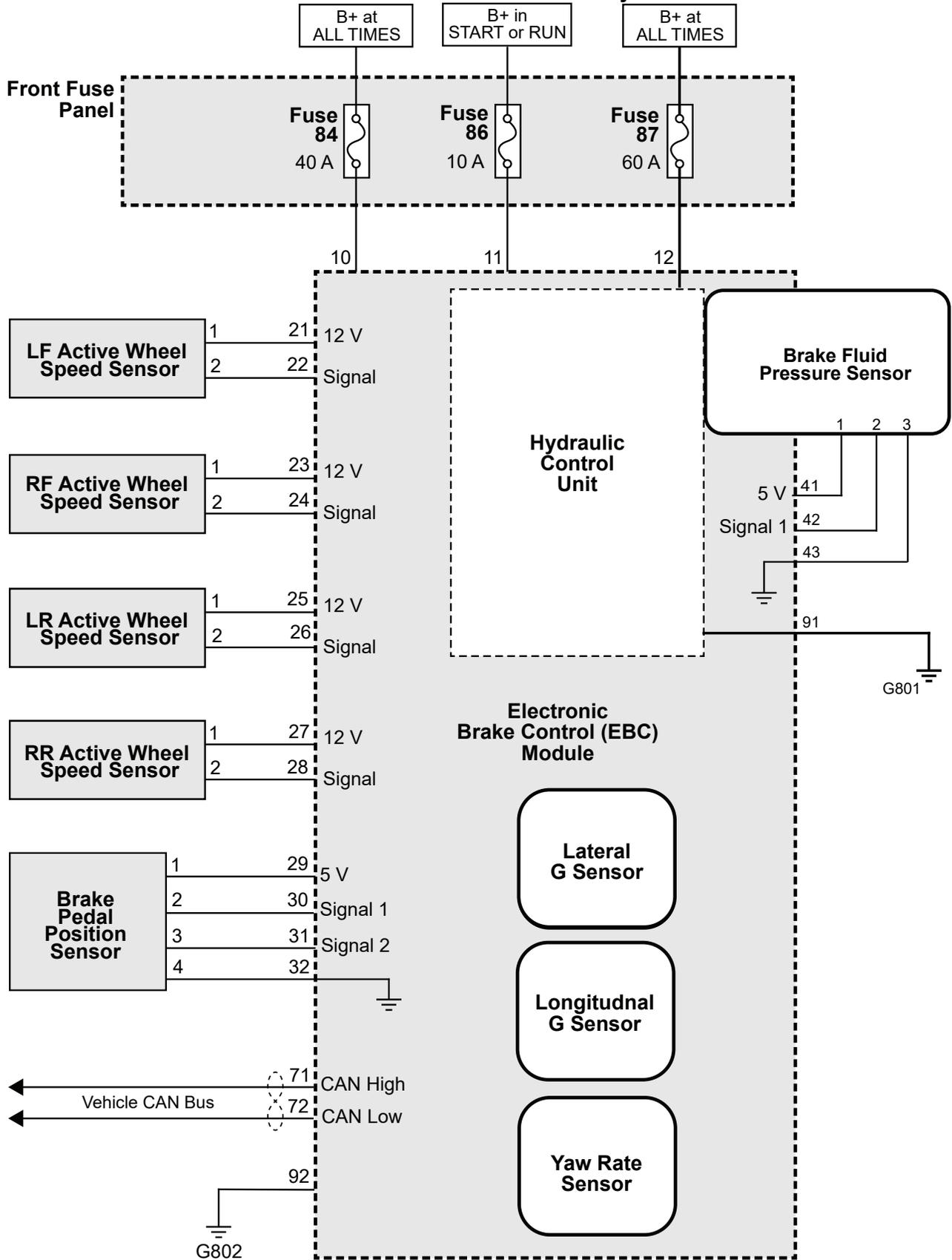
Infotainment Display Module / GPS Antenna Module / Telematics Control Module



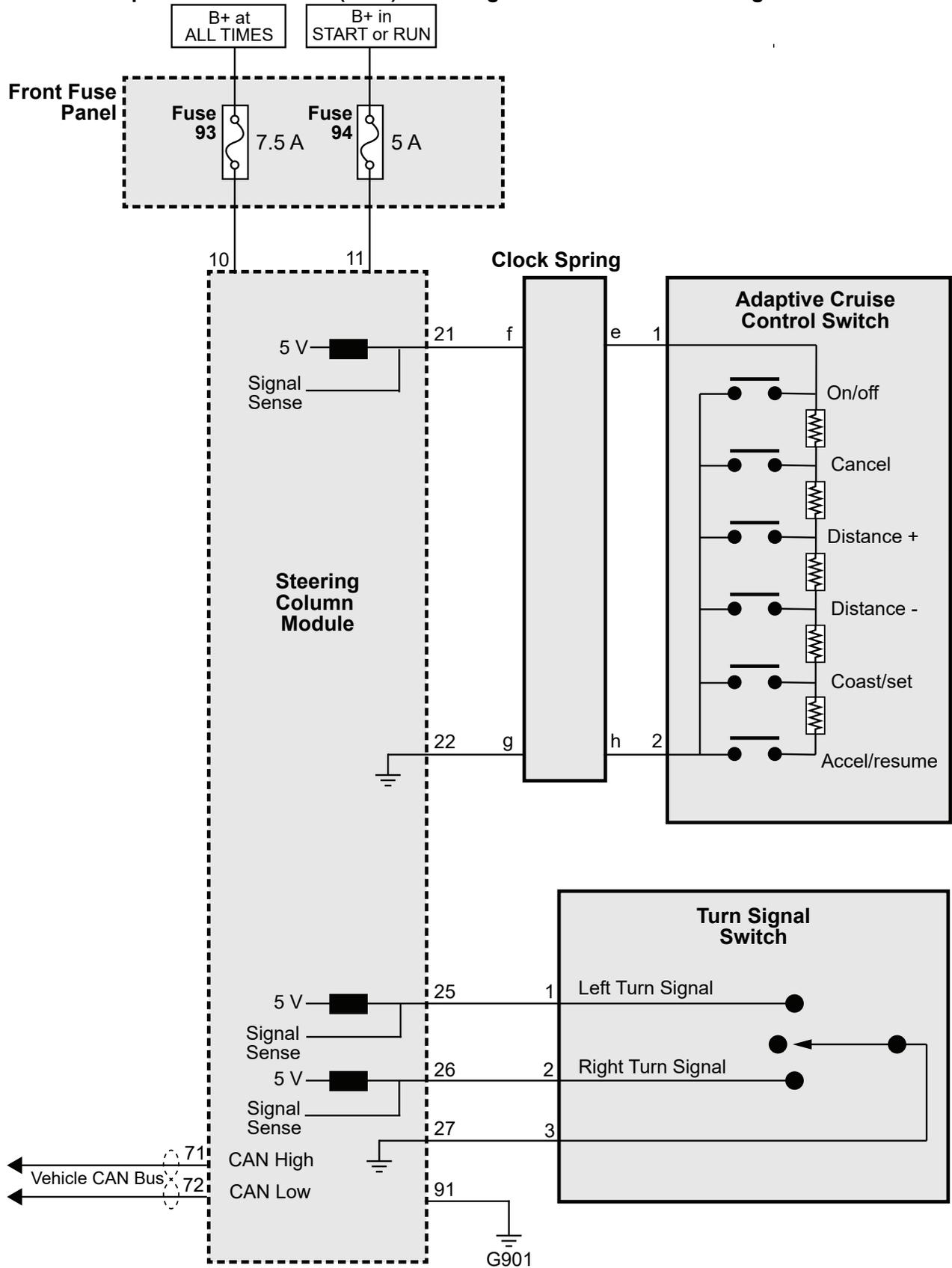
Electronic Power Steering System / Steering Wheel Vibration Actuator

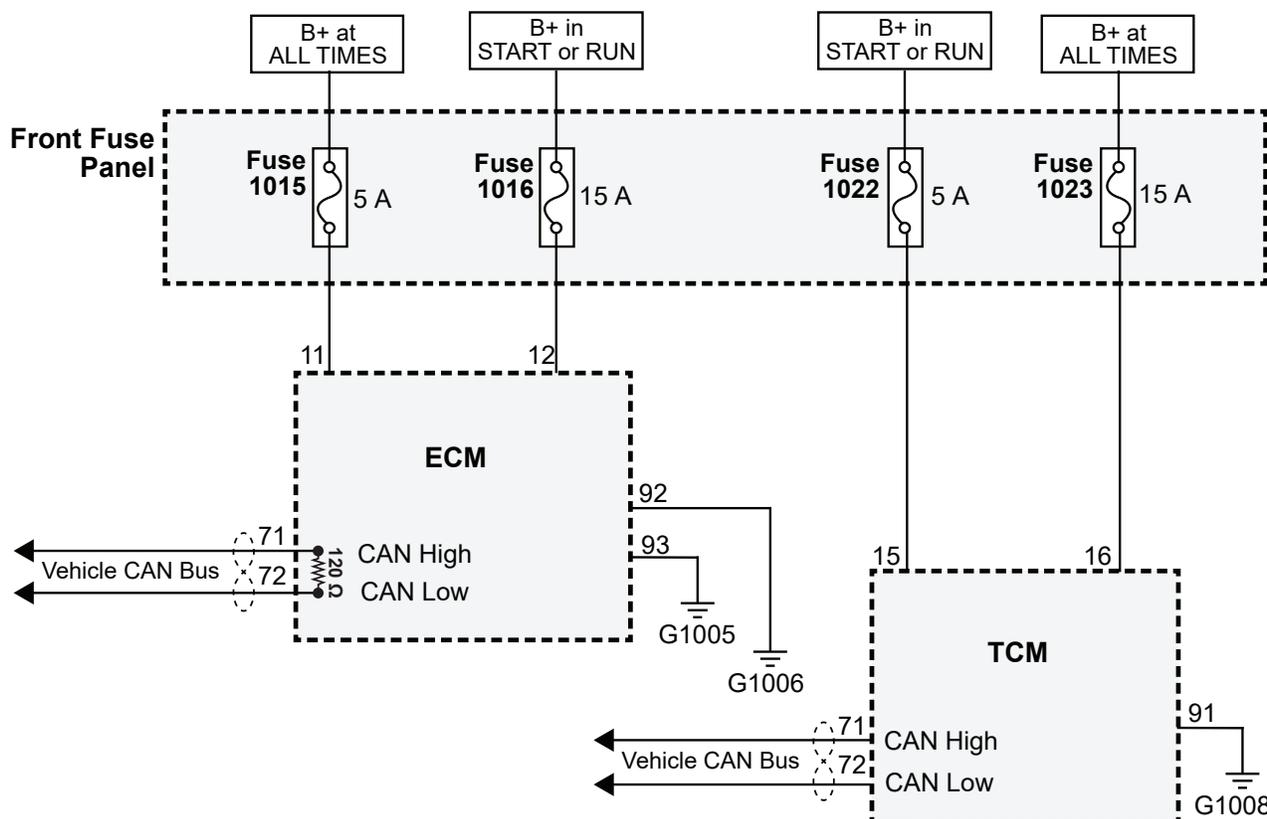
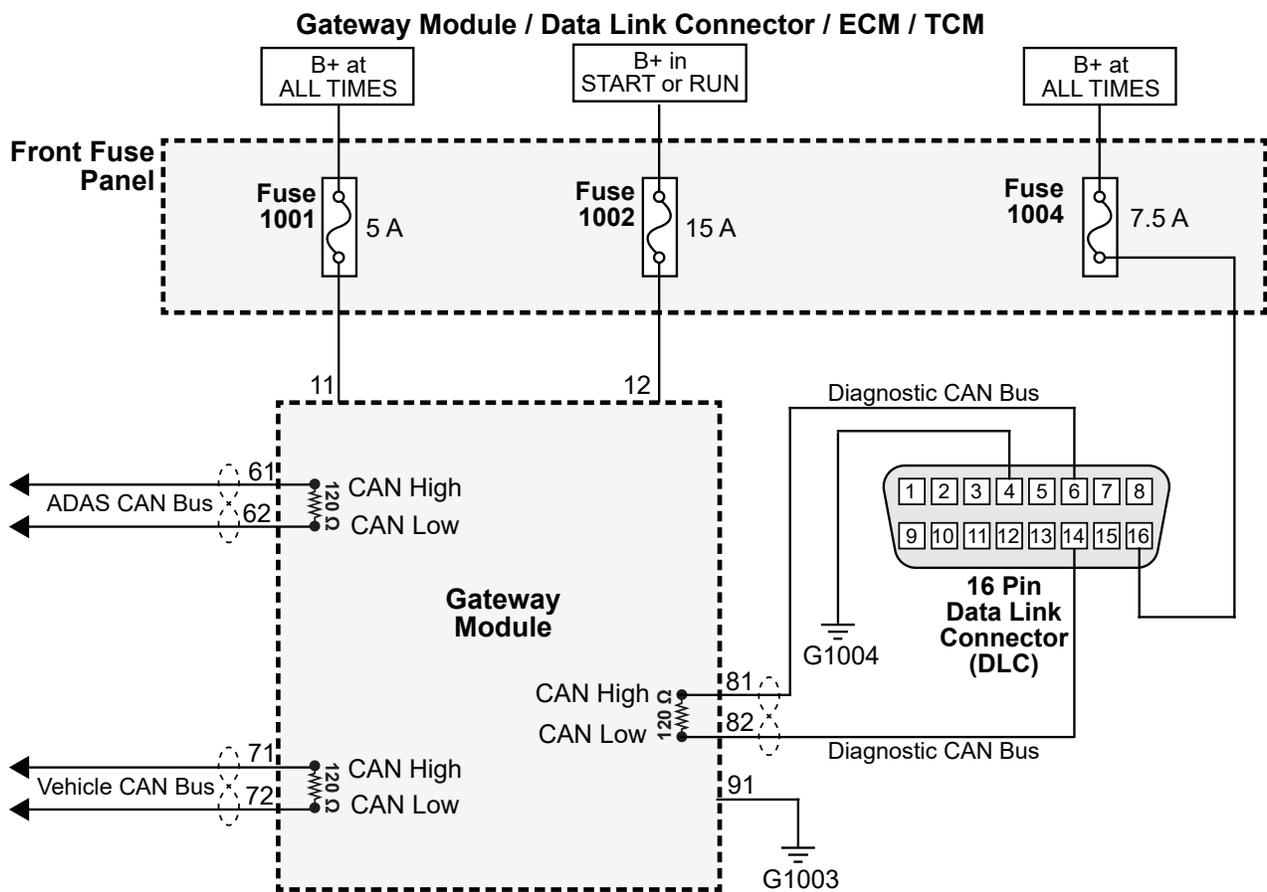


Electronic Brake Control System



Adaptive Cruise Control (ACC) / Steering Column Module / Turn Signal Switch





Terminal / Component Cross Reference

Parking Collision Warning System Module - p. 32	
Terminal #	Circuit Description
10	Keep alive memory
11	Module supply switched voltage
21	Left Front Ultrasonic Sensors 12 Volt Supply
22	Left Front Corner Ultrasonic Sensor Signal
23	Left Front Mid Ultrasonic Sensor Signal
24	Left Front Center Ultrasonic Sensor Signal
25	Left Front Ultrasonic Sensors Ground
26	Left Rear Ultrasonic Sensors 12 Volt Supply
27	Left Rear Corner Ultrasonic Sensor Signal
28	Left Rear Mid Ultrasonic Sensor Signal
29	Left Rear Center Ultrasonic Sensor Signal
30	Left Rear Ultrasonic Sensors Ground
31	Right Front Ultrasonic Sensors 12 Volt Supply
32	Right Front Corner Ultrasonic Sensor Signal
33	Right Front Mid Ultrasonic Sensor Signal
34	Right Front Center Ultrasonic Sensor Signal
35	Right Front Ultrasonic Sensors Ground
36	Right Rear Ultrasonic Sensors 12 Volt Supply
37	Right Rear Corner Ultrasonic Sensor Signal
38	Right Rear Mid Ultrasonic Sensor Signal
39	Right Rear Center Ultrasonic Sensor Signal
40	Right Rear Ultrasonic Sensors Ground
51	Warning Chime 12 Volt Supply
52	Warning Chime Control (PWM)
61	ADAS CAN High
62	ADAS CAN Low
91	Module Ground
Forward Radar Module - p. 33	
Terminal #	Circuit Description
11	Module supply switched voltage
61	ADAS CAN High
62	ADAS CAN Low
91	Module Ground

Left Rear Corner Radar Module - p. 33	
Terminal #	Circuit Description
13	Module supply switched voltage
21	Left Blind Spot Warning Indicator Control
63	ADAS CAN High
64	ADAS CAN Low
71	Private CAN Low
72	Private CAN High
93	Module Ground
Right Rear Corner Radar Module - p. 33	
Terminal #	Circuit Description
15	Module supply switched voltage
23	Right Blind Spot Warning Indicator Control
84	Private CAN High
86	Private CAN Low
94	Module Ground
Multifunction Forward Radar Module - p. 34	
Terminal #	Circuit Description
11	Module supply switched voltage
51	Multifunction Forward Facing Camera Heater Control
71	ADAS CAN High
72	ADAS CAN Low
91	Module Ground
ADAS Central Module - p. 34	
Terminal #	Circuit Description
11	Module supply switched voltage
57	Stop Lamp Monitor
58	Stop Lamp Control
74	Vehicle CAN High
75	Vehicle CAN Low
78	ADAS CAN High
79	ADAS CAN Low
93	Module Ground

Terminal / Component Cross Reference

Surround View Camera Module - p. 35	
Terminal #	Circuit Description
11	Module keep alive voltage
12	Module supply switched voltage
21	Front, Left, & Right Surround View Camera 6 Volt Supply
22	Front Surround View Camera Control
23	Left Surround View Camera Control
24	Right Surround View Camera Control
25	Reverse Lamp Signal Input
26	Rear Surround View Camera 6 Volt Supply
27	Rear Surround View Camera Control
61	ADAS CAN High
62	ADAS CAN Low
91	Module Ground
x1	Front Surround View Camera High Speed Video In
x2	Left Surround View Camera High Speed Video In
x3	Right Surround View Camera High Speed Video In
x4	Rear Surround View Camera High Speed Video In
x5	High Speed Video Out to Infotainment Display Module
Instrument Cluster Module - p. 36	
11	Module keep alive voltage
12	Module supply switched voltage
21	ADAS Control Panel Signal +
22	ADAS Control Panel Signal -
71	Vehicle CAN High
72	Vehicle CAN Low
91	Module Ground
Infotainment Display Module - p. 37	
Terminal #	Circuit Description
11	Module keep alive voltage
12	Module supply switched voltage
61	ADAS CAN High
62	ADAS CAN Low
91	Module Ground
x13	Surround View System High Speed Video In

GPS Antenna Module - p. 37	
Terminal #	Circuit Description
13	Module keep alive voltage
14	Module supply switched voltage
93	Module Ground
x12	GPS High Speed Data Out to Infotainment Display Module
x14	GPS High Speed Data Out to Telematics Control Module
Telematics Control Module - p.37	
Terminal #	Circuit Description
18	Module keep alive voltage
19	Module supply switched voltage
65	ADAS CAN High
66	ADAS CAN Low
95	Module Ground
x15	GPS High Speed Data In
Electronic Power Steering Module - p. 38	
Terminal #	Circuit Description
12	Module keep alive voltage
13	Module supply switched voltage
14	Electronic Power Steering Motor Supply Voltage
21	Steering Shaft Torque Sensor 12 Volt Supply
22	Steering Shaft Torque Sensor Signal 1
23	Steering Shaft Torque Sensor Signal 2
24	Steering Shaft Torque Sensor Ground
51	Steering Wheel Vibration Actuator 12 Volt Supply
52	Steering Wheel Vibration Actuator Control
71	Vehicle CAN High
72	Vehicle CAN Low
91	Electronic Power Steering Motor Ground
93	Module Ground

Terminal / Component Cross Reference

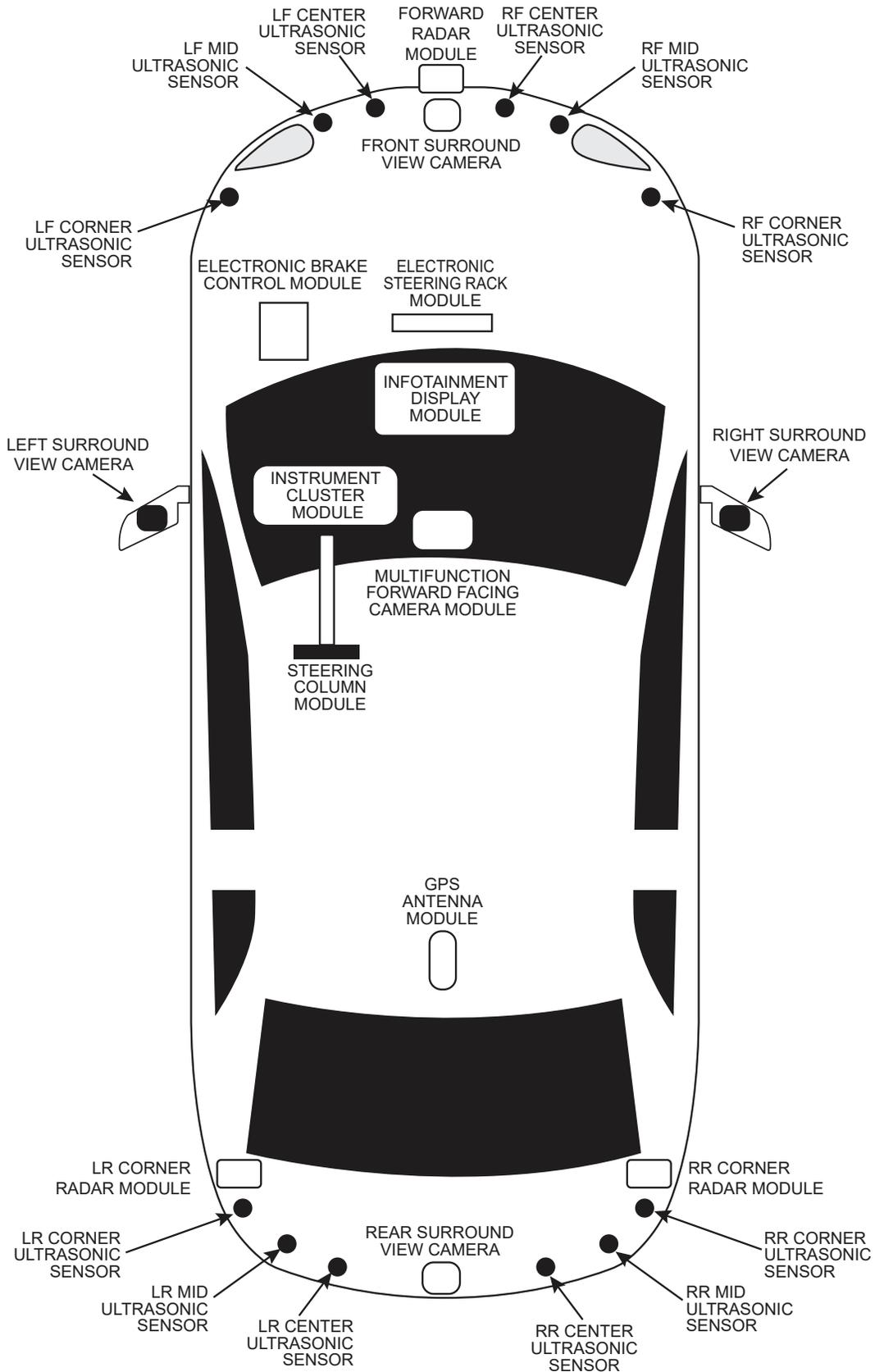
Electronic Brake Control Module - p. 39	
Terminal #	Circuit Description
10	Module keep alive voltage
11	Module supply switched voltage
12	Hydraulic Control Unit Supply Voltage
21	LF Active Wheel Speed Sensor 12 Volt Supply
22	LF Active Wheel Speed Sensor Signal
23	RF Active Wheel Speed Sensor 12 Volt Supply
24	RF Active Wheel Speed Sensor Signal
25	LR Active Wheel Speed Sensor 12 Volt Supply
26	LR Active Wheel Speed Sensor Signal
27	RR Active Wheel Speed Sensor 12 Volt Supply
28	RR Active Wheel Speed Sensor Signal
29	Brake Pedal Position Sensor 5 Volt Supply
30	Brake Pedal Position Sensor Signal 1
31	Brake Pedal Position Sensor Signal 2
32	Brake Pedal Position Sensor Ground
41	Brake Fluid Pressure Sensor 5V Supply
42	Brake Fluid Pressure Sensor Signal 1
43	Brake Fluid Pressure Sensor Ground
71	Vehicle CAN High
72	Vehicle CAN Low
91	Hydraulic Control Unit Ground
92	Module Ground
Steering Column Module - p. 40	
Terminal #	Circuit Description
10	Module keep alive voltage
11	Module supply switched voltage
21	Adaptive Cruise Control Switch Signal +
22	Adaptive Cruise Control Switch Signal -
25	Left Turn Signal +
26	Right Turn Signal +
27	Turn Signal Switch Signal -
71	Vehicle CAN High
72	Vehicle CAN Low
91	Module Ground

Gateway Module - p. 41	
Terminal #	Circuit Description
11	Module keep alive voltage
12	Module supply switched voltage
61	ADAS CAN High
62	ADAS CAN Low
71	Vehicle CAN High
72	Vehicle CAN Low
81	Diagnostic CAN High
82	Diagnostic CAN Low
91	Module Ground
Engine Control Module - p. 41	
Terminal #	Circuit Description
11	Module keep alive voltage
12	Module supply switched voltage
71	Vehicle CAN High
72	Vehicle CAN LOW
92	Module Ground
93	Module Ground
Transmission Control Module - p. 41	
Terminal #	Circuit Description
15	Module supply switched voltage
16	Module keep alive voltage
71	Vehicle CAN High
72	Vehicle CAN Low
91	Module Ground

Fuse / Component Cross Reference

Fuse #	Component	Page
10	Parking Collision Warning System Module	32
12	Parking Collision Warning System Module	32
20	Forward Radar Module	33
22	Left Rear Corner Radar Module	33
22	Right Rear Corner Radar Module	33
32	Multifunction Forward Facing Camera Module	34
33	Multifunction Forward Facing Camera Heater	34
35	ADAS Central Module	34
36	Stop Lamp Relay	34
37	Stop Lamp Relay	34
41	Surround View Camera Module	35
42	Surround View Camera Module	35
44	Reverse Lamp Relay	35
45	Reverse Lamp Relay	35
55	Instrument Cluster Module	36
56	Instrument Cluster Module	36
62	Infotainment Display Module	37
63	Infotainment Display Module	37
64	Telematics Control Module	37
65	Telematics Control Module	37
66	GPS Antenna Module	37
67	GPS Antenna Module	37
70	Steering Angle Sensor	38
71	Electronic Steering Module	38
72	Electronic Steering Module	38
84	Electronic Brake Control Module	39
86	Electronic Brake Control Module	39
87	Hydraulic Control Unit	39
93	Steering Column Module	40
94	Steering Column Module	40
1001	Gateway Module	41
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ADAS COMPONENT LOCATION





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