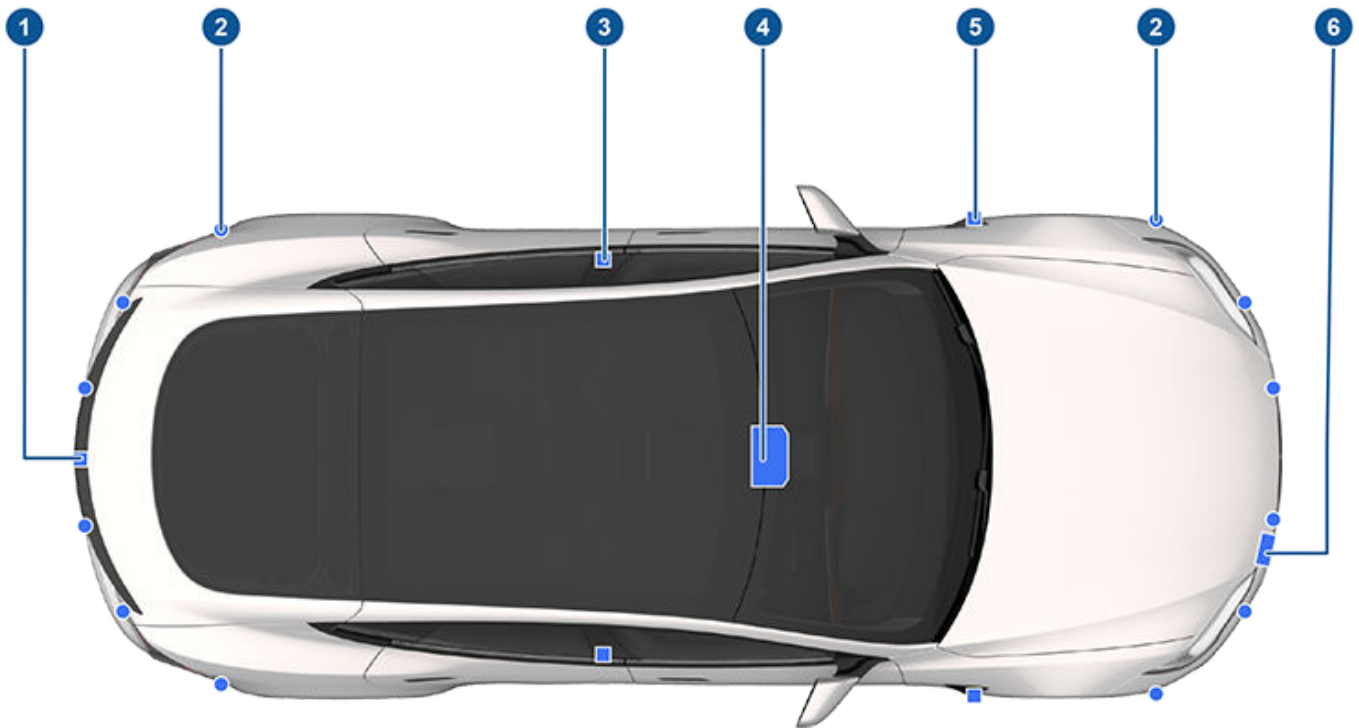## How It Works

Your Model S includes the following components that actively monitor the surrounding area:

1. A camera is mounted above the rear license plate.
2. Ultrasonic sensors are located in the front and rear bumpers.
3. A camera is mounted in each door pillar.
4. Three cameras are mounted to the windshield above the rear view mirror.
5. A camera is mounted to each front fender.
6. Radar (if equipped) is mounted behind the front bumper.

Model S is also equipped with high precision electronically-assisted braking and steering systems.

In addition, the cabin camera can determine driver inattentiveness and provide alerts when Autopilot is engaged. By default, data from the camera does not leave the vehicle itself. In other words, data is not saved or transmitted unless you enable data sharing. To enable data sharing, touch **Controls** > **Software** > **Data Sharing** > **Allow Cabin Camera Analytics**. Cabin Camera Analytics helps Tesla continue to develop even safer vehicles in the future. See Cabin Camera on page 120.

NOTE: Ensure all cameras and sensors (if equipped) are clean before each drive. See Cleaning Cameras and Sensors on page 85 for more information. Dirty cameras and sensors, as well as environmental conditions such as rain and faded lane markings, can affect Autopilot performance.

Active Safety Features

These Active Safety features are designed to increase your safety:

- Lane Assist (see Lane Assist on page 113)
- Collision Avoidance Assist (see Collision Avoidance Assist on page 116)
- Speed Assist (see Speed Assist on page 119)
- Cabin Camera (see Cabin Camera on page 120)

You can enable/disable some of these features and in some cases, control how they work. To access settings for these features, touch **Controls** > **Autopilot**.

Autopilot Features

NOTE: *Depending on market region, vehicle configuration, options purchased, software version and build date, your vehicle may not be equipped with all features listed below, or a feature may not operate as described.*

These Autopilot convenience features are designed to reduce driver workload:

- Traffic-Aware Cruise Control (see Traffic-Aware Cruise Control on page 86)
- Autosteer (see Autosteer on page 90)
- Auto Lane Change (see Auto Lane Change on page 92)
- Autopark (see Autopark on page 105)
- Summon (see Summon on page 107)
- Smart Summon (Smart Summon on page 110)
- Stop Light and Stop Sign Warning (see Stop Light and Stop Sign Warning on page 93)
- Navigate on Autopilot (see Navigate on Autopilot on page 95)
- Traffic Light and Stop Sign Control (see Traffic Light and Stop Sign Control on page 98)

You can enable/disable some of these features and in some cases, control how they work. To access settings associated with these features, touch **Controls** > **Autopilot**.

Drive to Calibrate Cameras

Model S must maneuver with precision when Autopilot features are being used. Therefore, before some features can be used for the first time or after some types of service repairs, cameras must complete a self-calibration process. For your convenience, the instrument panel displays a progress indicator.

When calibration is complete, Autopilot features are available for use. Calibration typically completes after driving 20-25 miles (32-40 km), but the distance varies depending on road and environmental conditions. For example, calibration completes quicker when driving on a straight road with multiple lanes (such as a controlled-access highway), with highly-visible lane markings (in the driving lane as well as the adjacent lanes). Contact Tesla only if your Model S has not completed the calibration process after driving 100 miles (160 km) in the described conditions.

If a camera has shifted from its calibrated position (for example, the camera or windshield was replaced), you must clear the calibration. To do so, touch **Controls** > **Service** > **Camera Calibration** > **Clear Calibration**. When the calibration is cleared, Model S repeats the calibration process. While this helps re-calibrate the cameras in many cases, **Clear Calibration** may not resolve all camera and sensor concerns.

NOTE: To calibrate, cameras require highly-visible lane markings in both the driving lane and adjacent lanes (at least two lanes over on each side of the vehicle). For best results, drive in the middle lane of a multi-lane highway (ideally with at least five lanes) that has clear lane markings and minimal traffic.

NOTE: If you attempt to use a feature that is not available until the calibration process is complete, the feature is disabled and the instrument panel displays a message.

NOTE: Model S must repeat the calibration process if the cameras are serviced by Tesla, and in some cases, after a software update.

Limitations

Many factors can impact the performance of Autopilot components, causing them to be unable to function as intended. These include (but are not limited to):

- Poor visibility (due to heavy rain, snow, fog, etc.).
- Bright light (due to oncoming headlights, direct sunlight, etc.).
- Damage or obstructions caused by mud, ice, snow, etc.
- Interference or obstruction by object(s) mounted onto the vehicle (such as a bike rack).
- Obstruction caused by applying excessive paint or adhesive products (such as wraps, stickers, rubber coating, etc.) onto the vehicle.
- Narrow or winding roads.
- A damaged or misaligned body panel.
- Use of gray or aftermarket glass.
- Interference from other equipment that generates ultrasonic waves.
- Extremely hot or cold temperatures.

⚠️ **CAUTION:** If a windshield replacement is needed, take your vehicle to Tesla Service. This ensures appropriate handling and mounting of the camera(s). Failure to do so can cause one or more Autopilot features to malfunction.

⚠️ **WARNING:** The list above does not represent an exhaustive list of situations that may interfere with proper operation of Autopilot components. Never depend on these components to keep you safe. It is the driver's responsibility to stay alert, drive safely, and be in control of the vehicle at all times.

⚠️ **WARNING:** Advanced safety features may not be available during the calibration period.

⚠️ **WARNING:** Re-calibrating the cameras or sensors (if equipped) on the touchscreen is not a substitute for checking the physical positioning and condition of these components. Walk around your vehicle and inspect the cameras and sensors for physical damage. Incorrectly calibrated or positioned cameras and sensors may limit or disable the use of safety features. Contact Tesla if you suspect lingering issues.

Cleaning Cameras and Sensors

To ensure the various Autopilot components can provide information that is as accurate as possible, keep cameras and sensors (if equipped) clean and free of obstructions, condensation, or damage (see Cleaning on page 178).

Condensation can form inside the camera enclosures, especially if you park your vehicle outside in cold or wet conditions. The instrument cluster may display an alert stating that a camera is blocked and that some or all Autopilot features may be temporarily restricted until the camera vision is clear. To proactively dry the condensation, precondition the cabin by setting it to a warm temperature, turning the windshield defroster on, and directing the front air vents toward the door pillars (see Mobile App on page 159).

⚠️ **CAUTION:** Do not wipe an exposed lens with your hands or a cloth in an attempt to remove dirt or debris. The debris can damage the surface of the lens when wiped.

⚠️ **CAUTION:** Do not use chemical-based or abrasive cleaners. Doing so can damage surfaces.

⚠️ **CAUTION:** Do not clean an ultrasonic sensor (if equipped) or camera lens with a sharp or abrasive object that can scratch or damage its surface.