# *Gatekeeping Soldiers Protect ADAS Power Supply Voltage Integrity*

The capabilities of vehicle electronics are growing by leaps and bounds as judicious drivers require more electrical driver assistance. Drivers expect this kind of help from a car that "sees" activity within a 360° radius. This predecessor to driverless cars is called the Advanced Driver Assistance Systems or ADAS (Figure 1).

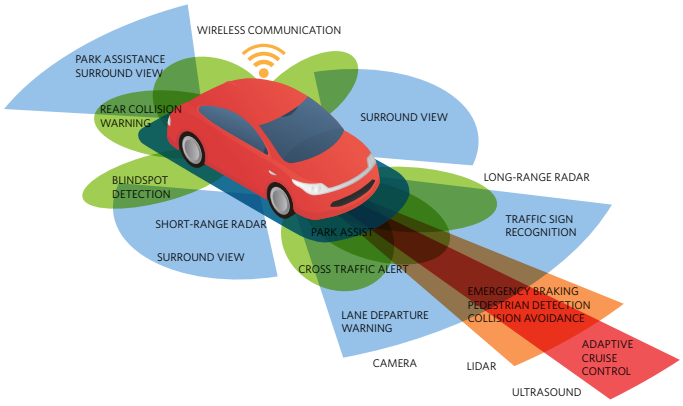


*Figure 1. ADAS Addresses Proximity Challenges with an Array of Sensors and Background Electronics*

The ADAS circuit deployment requires detailed attention to functional automotive safety. Thanks to innovative semiconductor technologies, these electrical circuits rely on an array of IC voltage supervisors to ensure that the system's voltages are within "healthy" limits. This design solution evaluates the supervisor's role as it relates to vehicle functional safety requirements and its supply voltage $\overline{\text{RESET}}$ alert capability to notify the system of a bad or missing power supply.

## Vehicle Safety

The ISO 26262, entitled "Road Vehicles — Functional Safety," defines the international automobile standard for electrical and electronic systems. ISO 26262 targets three possible hazards caused by automobile safety-related electrical malfunctions: the potential for human injury, controllable failure severity, and risk exposures. These principles determine the Automotive Safety Integrity Level (ASIL) rating that ranges from level A to level D, with level D indicating the most robust system.

The two ways to create an ASIL-compliant system are to use ASIL-compliant ICs or voltage supervisor circuitry. The supervisor circuit provides appropriate voltage detection, diagnosis, and validation.

## Advanced Driver Assistance Systems

Current and future ADAS solutions contain cameras, long-range radar, ultrasound, as well as light detecting and ranging (LiDAR) sensing technologies. These sensors and their support systems collect an enormous amount of traffic and pedestrian data. Automotive microcontrollers and processors convert sensor data to information critical for driver safety with immediate driver notifications and driverless evasive actions.

There is a common thread with these electronic systems. If the power supply voltage in the camera, ultrasound, long-range radar, or LiDAR electronics fails to provide enough voltage levels, the ADAS system's ability to accurately sense and ascertain the automobile's environment is negatively impacted. This potential inability to sense the automotive surroundings can create a functional safety crisis unless there are circuit devices that notify the system of power supply problems.

## The Power Supply Gatekeeper

Across these sensor systems is an army of gatekeepers or voltage supervisors. Voltage supervisors perform several different tasks as they monitor supply voltage rails. A low-power event can degrade the effectiveness or accuracy of a sensor circuit. A high-power event can damage an IC's internal traces or transistors, and a no-power or power-down condition completely disconnects the power supply's sensors from the ADAS.

Voltage supervisors detect, diagnose, and report the status of the various system supply voltages, thereby preventing unsafe supply conditions (Figure 2).

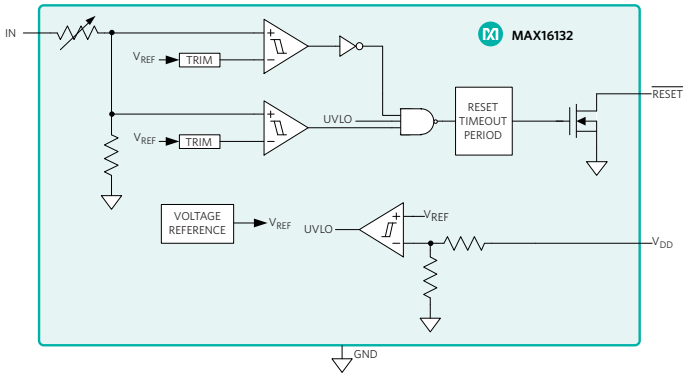


*Figure 2. Single-Channel Voltage Supervisor Compares Input Voltage to the Undervoltage and Overvoltage*

In Figure 2, the voltage supervisor uses internal comparators to evaluate low-, high-, or power-down input conditions. The voltage supervisor sends a reset signal to the attached microcontroller if the voltage input (IN) violates the pre-programmed undervoltage (UV).

Most voltage supervisor circuits provide an undervoltage monitoring feature while advanced circuits also monitor overvoltage thresholds (OV) to provide window detection capability.

The reset pin maintains its output-voltage signal level for a minimum timeout period after the input voltage returns to within the factory-set window thresholds.

### The Supervisor's Complexion

The ADAS sensing circuits require several different voltage rails for devices such as amplifiers, analog-to-digital converters, radar transceivers, communication channels, and microcontrollers. Examples of power supply voltages for these systems are 1.8V, 2.5V, 3.3V, and 5V. Each power supply requires its own voltage supervisor.

The voltage supervisor assists in monitoring the supply voltages at levels between pre-programmed window voltages. With an internal voltage reference, supervisors create an undervoltage (UV) lower window threshold and an overvoltage (OV) upper window threshold (Figure 3).

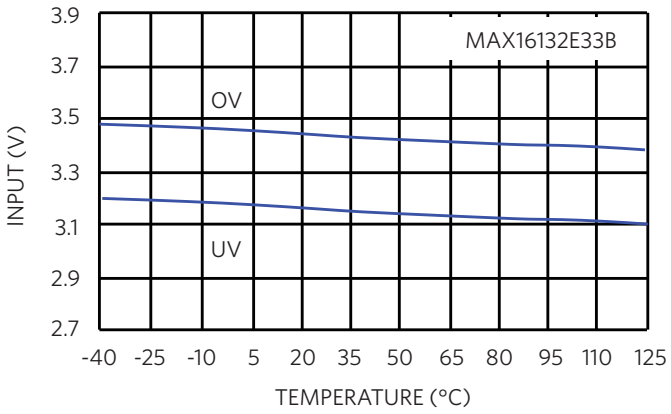


*Figure 3. The ±5% Undervoltage (UV) and Overvoltage (OV) Performance Over Temperature of a 4V Voltage Supervisor*

In Figure 3, the programmed nominal input voltage of the single-channel voltage supervisor is 3.3V, and the percentage of the UV and OV threshold is 4% (factory programmed). At 25°C, UV equals 3.168V and OV equals 3.432V. The reset timeout period for this device is 5ms. The data in Figure 3 also demonstrates the temperature stability of the voltage supervisor.

The voltage supervisor has internal hysteresis at the window thresholds to avoid noise-causing multiple transitions or fault conditions. The factory-programmed hysteresis for the product in Figure 3 is 0.25%.

When ensuring proper operation, it is essential to monitor all rails for UV and OV conditions since cameras, long-range radar, ultrasound, and LiDAR sensing technologies independently report traffic conditions. For example, on a foggy day, a UV event could cause a long-range radar malfunction resulting in an unrecognized pedestrian in a crosswalk. OV events are equally important to track as they may indicate a damaging surge to an IC.

### Providing Safety Now and in the Future

The sophistication of automotive electronics now spans into ADAS applications. This expansion provides drivers with increased driver assistance, along with potential vehicle safety issues. The ISO 26262 ASIL ratings provide safety guidelines for automobile electrical and electronic systems to minimize human injury potential, controllable failure severity, and risk exposures.

The ISO 26262 standard ensures attention to functional automotive safety. In cameras, long-range radar, ultrasound, and light detecting radar (LiDAR) sensing subsystems, a collection of supply monitoring voltage supervisors confirms that ADAS power supply voltages are within operational limits.

To meet ISO 26262 standards, an array of ADAS voltage supervisors monitor various supply voltages. These supervisors monitor the system's power supplies for startup errors, power undervoltage, and overvoltage events. With the precision supervisor's $\overline{\text{RESET}}$ gatekeeper notifications, designers can have confidence their system power supplies will strengthen critical safety standards for ADAS applications.

Learn more:

MAX16132 Low-Voltage, Precision, Single/Dual/Triple/ Quad-Voltage µP Supervisor

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