

Sensata INSIGHTS ADAS Explainer – AP1 & KP2



Contents

1	What is ADAS?	3
2	How Does ADAS Work?	4
2.1	Speed Source for ADAS and Disclaimer	4
3	Technical Requirements	6
3.1	Device Installation	6
3.2	Manual Settings Adjustment	7
3.3	Device Firmware	7
4	ADAS Event Delivery	8
4.1	Event Transmission	8
4.2	Events Within INSIGHTS Applications	8
4.3	Event Integration for TSPs	8
5	KP2 Event Logic	10
5.1	HMW	10
5.2	FCW	11
5.3	LDW	12
6	AP1 Event Logic	13
6.1	HMW	13
6.2	FCW	13
6.3	LDW	15
7	Frequently Asked Questions	16
8	Appendix A	17
9	Appendix B	18

1 What is ADAS?

ADAS, or Advanced Driver Assistance Systems, consists of features that utilize sensors, image processing, and artificial intelligence (AI) to assist drivers and support safe driving behaviors. This Explainer focuses on two INSIGHTS devices, AP1 and KP2, with this functionality. Available in both devices are three ADAS event types:

- Forward Collision Warning (FCW)
Monitors and notifies drivers when a collision with the vehicle or obstacle ahead of them is imminent.
- Headway Monitoring Warning (HMW) or “Tailgating”
Notifies drivers when they infringe upon a configurable “unsafe” distance to the vehicle ahead.
- Lane Departure Warning (LDW)
Detects a vehicle drifting across a solid lane line.

To learn more about what logic governs different event types, skip to the appropriate section for either device. The same conceptual understanding of each event applies to both platforms.

On the next page, we will explore the flow of ADAS from device event capture to endpoint display.

2 How Does ADAS Work?

ADAS is primarily an edge function built into applicable INSIGHTS devices. The steps below outline a high-level overview of how ADAS events are processed.

- Two of our ADAS-enabled devices, AP1 and KP2, use cameras to capture visual information.
- Device images and data from the vehicle bus (e.g., OBDII) or GPS are constantly fed through ADAS processing libraries.
- AI algorithms analyze combined data to understand vehicle behavior on the road and determine whether an ADAS event occurred.
- If an event is identified, in-cabin audio alerts are triggered from the device (if configured).
- Events and event data transmits from the device to SmartAPI.
- If a TSP subscribes to ADAS event notifications, they will receive Gzipped JSON event messages as a callback message at their endpoint (see [Appendix A](#)).

For a visual representation of the end-to-end process, from image capture to event reception on your web application, see Figure 1 on the following page.

Get deployment started for your devices with our [Technical Requirements](#). Understanding what potential impediments could result in inadequate ADAS execution is essential.

2.1 Speed Source for ADAS and Disclaimer

FCW events require near-instantaneous processing to provide adequate preventative alerts to drivers. Accurate data input directly from the vehicle bus (OBDII or JBUS) supports FCW in the widest range of scenarios, making it the preferred method for deriving vehicle speed and informing TTC (Time to collision) calculations. To capture this data, use a data cable installation with either OBDII for passenger/light-duty vehicles or JBUS for heavy-duty vehicles.

Installations without an OBDII or J1939 data connection will use GPS as a speed source (2-wire, 3-wire, and cigarette adapter). Please note this feature is only available in mid-2022 firmware and later:

- AP1: FW Version 1.2.1 or greater
- KP2: FW Version 1.1.0 or greater

For the most robust ADAS functionality, INSIGHTS recommends installation using a OBDII or JBUS connection. For installations without vehicle data retrieval or in instances where speed is unobtainable from the vehicle, AP1 and KP2 default to GPS speed as a source for operating of ADAS features. ADAS alert generation will occur in fewer situations due to the nature of data inputs and can be further limited by the loss of GPS signal reception. **Once ADAS features are enabled, users assume full responsibility and indemnify INSIGHTS for any incidents directly correlated with ADAS efficacy, malfunction, or delays.**

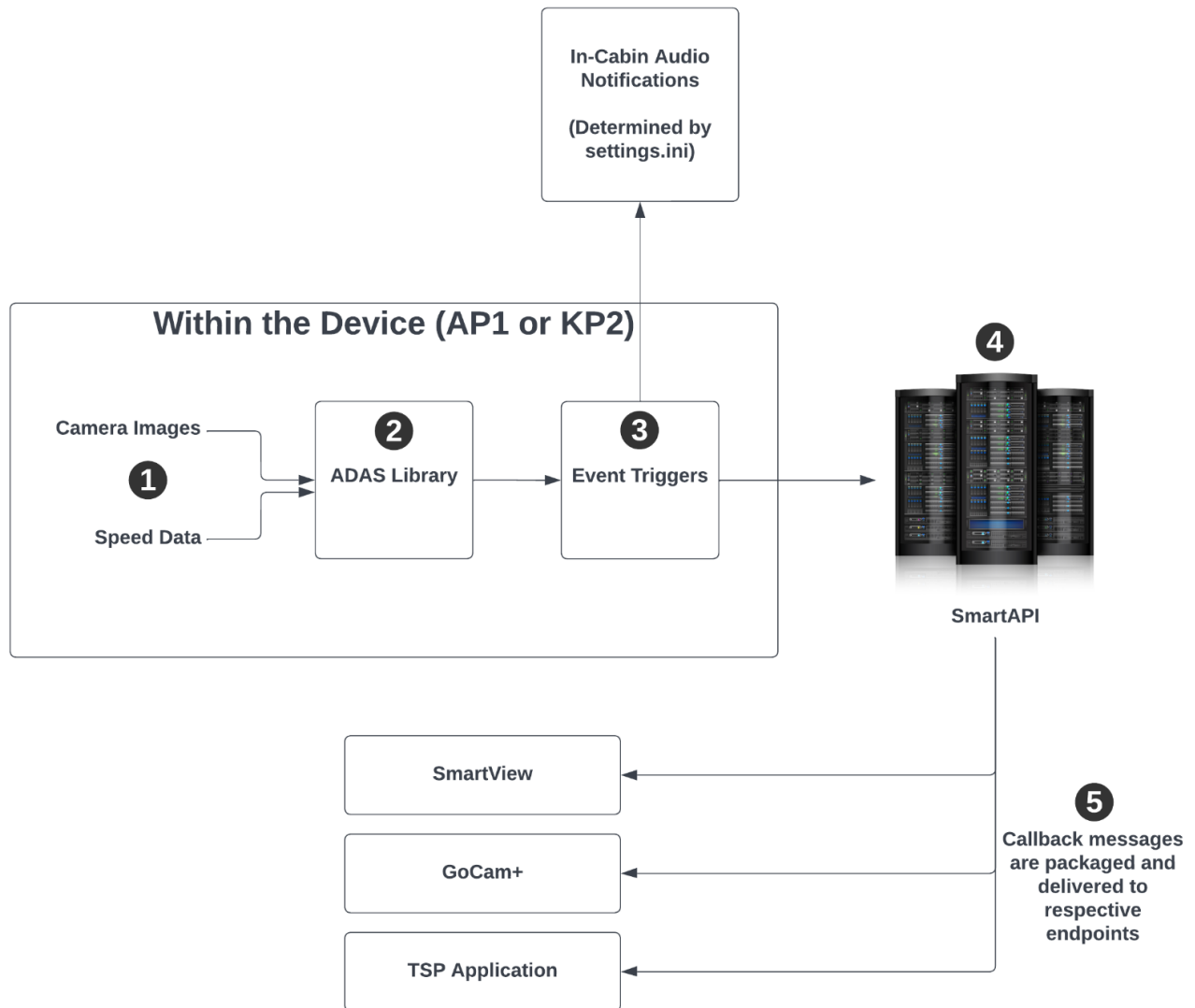


Figure 1

3 Technical Requirements

Implementing ADAS requires proper device and platform configuration. Follow the steps in this section to set up your customers for success.

3.1 Device Installation

For proper device setup, follow these general rules for optimal ADAS performance:

- The road-facing camera must have an unobstructed view swept by the vehicle's windshield wipers.
- Use the AP1 Calibration Tool and KP2 Installer mobile apps to guide device setup during the installation process.
- Provide accurate horizon and hood settings. The horizon setting helps ADAS functions identify the road and has a sizeable impact on event accuracy. For an example of improper camera angle settings in an AP1, review Figure 2 below. The true horizon line (white dashed line) is too far above the red guidelines and may skew performance; it must be within the red guidelines when calibrating the AP1. Hood settings act as a mask to focus on the area of concern within the camera's field of view.

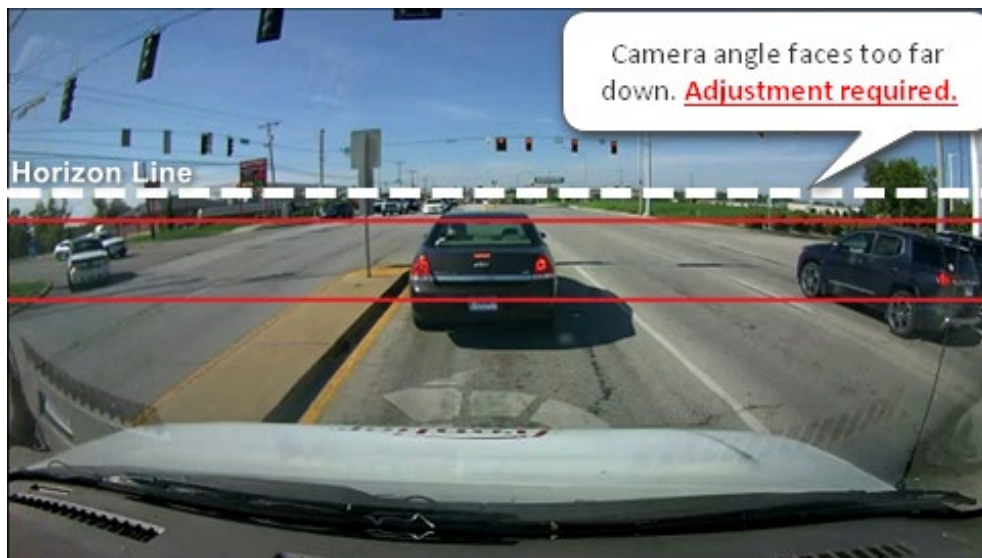


Figure 2

- Provide accurate device installation settings. Values such as camera height are important factors in calibrating ADAS for optimal performance. Setting specifications differ slightly in each device and different vehicle types.
- Ensure that the device's power type (e.g., 3-wire or OBDII-PWR) is expressed in the settings.ini file. This key value pair is updated manually and informs device functions. Please contact support or your integration team if you are unaware of how to establish this setting.



3.2 Manual Settings Adjustment

Some TSPs prefer to adjust the granular details of their device's ADAS specifications. For more hands-on or advanced integration teams, use either device's Configuration Tool. Review each setting value in this document or in each device's configuration tool guide on the [Knowledge Base](#). Settings files created using Configuration Tools can be distributed over-the-air to devices using the Workstation.

3.3 Device Firmware

We recommend keeping device firmware up to date to take advantage of the latest ADAS libraries. The best method for updating device firmware is OTA (over-the-air) via the SmartAPI Workstation. Go to the **Device Management** tab and select **Update Firmware** to open the "Update Firmware..." pop-up window. Follow the selection prompts to complete the process.

Note: Resellers are recommended to contact Support for assistance with firmware upgrades.

4 ADAS Event Delivery

Once your devices are installed and configured properly, there are additional steps to activate the event type in the SmartAPI platform and build ADAS into your application framework.

Note: The sections below are explicitly for partners (TSPs) that utilize in-house applications to feature INSIGHTS devices and data or have dedicated development teams. We recommend that smaller-scale resellers contact Support for assistance with deployment and ADAS integration.

4.1 Event Transmission

It is required first to enable ADAS in the Workstation before seeing the event type appear in your web platform. This allows SmartAPI to process ADAS events triggered at the device level and packages them in messages transferred to your endpoint.

1. Open the Workstation.
2. In Configuration, go to TSP Event Notifications. Activate ADAS notifications for individual customers in Configuration > Customers > Customer Event Notifications.
3. Under **Event Type**, locate **ADAS (KP2) (AP1)**. Select **Enabled** to turn on the feature. For a sample event message format, see [Appendix A](#).
4. To automatically capture video or images when ADAS events are triggered, select **Capture Video** or **Capture Image**. For a sample ManualBackup message format, see [Appendix B](#).

This setting change sends events from SmartAPI as a callback to TSPs' callback URL and ensures ADAS events are delivered to INSIGHTS applications.

4.2 Events Within INSIGHTS Applications

For SmartView, GoCam+, and Elastic, ADAS is one of the event categories digested and displayed on the platform. Once event transmission is enabled per the above, no further action is needed.

4.3 Event Integration for TSPs

Depending on your initial integration with SmartAPI, you may need additional work to access ADAS events in your application or user interface. If you are transferring callback messages to your database, you will need to track these accordingly. To accommodate the ADAS event type in your application, consider your front-end capabilities to display ADAS events in context. For an example of ADAS deployment in a user interface, please review the screen capture from SmartView in Figure 3.

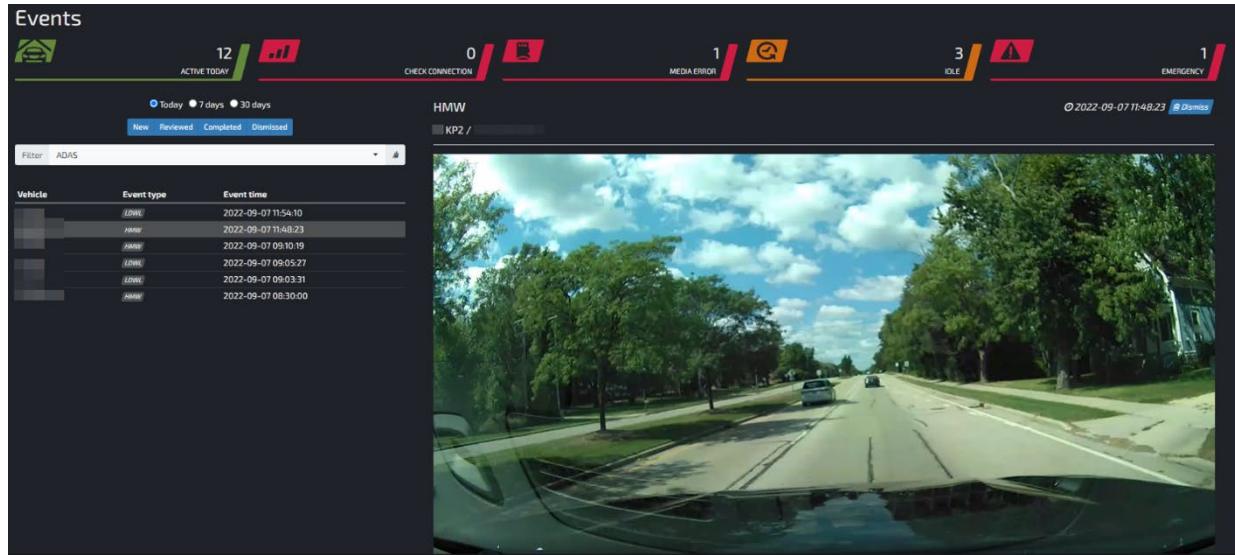


Figure 3

5 KP2 Event Logic

ADAS within KP2 harnesses rapid video processing to evaluate the road and determine if an event occurred. Review the sections featured below to understand event detection and alerting details. Resellers who need assistance should contact Support.

5.1 HMW

Detection Conditions

- HMW has three distinct speed ranges (low/middle/high) for detecting headway distances, with corresponding distance thresholds.
- Vehicle must be moving within the configured speed range.
- The furthest threshold distance is 20 meters or approximately 66 feet.

Configuration Values

- **Sensitivity:** Amount of time your vehicle must be within the speed/distance window to trigger an event.
- **Speed:** Speed range for HMW activation. Within this range, KP2 will generate HMW events. These values range from 40 kph/25 mph to 160 kph/100 mph. A configurable threshold must be surpassed for HMW in each speed window.
- **Distance:** The distance threshold from the front end of the driver's vehicle to the rear end of the vehicle ahead. When the device ADAS library determines the driver's vehicle violates this threshold, an alert is generated.
- **Speaker:** Select the conditions in which a driver receives audible alerts. Sound type settings are determined in the configuration tool (Info > Service > Voice Type).
- **Detect Interval:** A period of time that represents a single event during which the device will disregard repeated tailgating instances. For example, if the detect interval is set to 10 seconds, and an event is triggered continuously for 10 seconds or less, then only one event is delivered.
- **Multiple Event Escalation Time:** Period of time that qualifies events with greater severity ("Level 2" or Lv2). If your vehicle exceeds the number of tailgating instances set in the Lv2 Counter during the Multiple Event Escalation Time, the event raises to Lv2. For example, with an Escalation Time of 100 seconds and an Lv2 Counter set to "3," and an event triggers more than three times in 100 seconds, then the event escalates to Lv2.
- **Lv2 Counter:** The number of tailgating event instances required during the Multiple Event Escalation Time to escalate the event.

Note: Lv2 is not a separate event type. It is an HMW event with a different payload sent to the server.

5.2 FCW

Detection Conditions

- The vehicle must surpass a minimum speed and be moving within the configured speed range.
- After a previous FCW event trigger, subsequent FCW triggers will only occur once the vehicle exceeds 5 meters/16 feet from the vehicle in front for more than 2 seconds.

Configuration Values

- **Speed:** Speed at which FCW activates. Above this speed, KP2 will generate FCW events. This value ranges from 40 kph/25 mph to 160 kph/100 mph. The minimum speed when GPS is the ADAS speed source is 60 kph/37 mph, even if the value is configured differently.
- **TTC:** Time to Collision. This value is calculated through the device's ADAS library. It's based on the driver's vehicle speed and the apparent speed of the vehicle ahead. We recommend that the higher you set your speed threshold, the greater the TTC should be to lend your drivers enough reaction time to avoid incidents. TTC calculation resolution time differs as you increase the setting (0.1 sec if $TTC < 1$ sec, 0.5 sec if $TTC > 1$ sec), so be mindful that alerts may reach drivers quicker in situations requiring shorter response times.
- **Speaker:** Enables in-cabin alerts. Sound type settings are determined in the configuration tool (Info > Service > Voice Type).
- **Detect Interval:** A period of time that represents a single event during which the device will disregard repeated FCW instances. For example, if the detect interval is set to 10 seconds, an FCW event cannot be followed by another for at least 10 seconds.

5.3 LDW

Detection Conditions

- Vehicles must surpass a minimum speed to enable LDW.
- Event type only recognizes **solid** lane lines.

Configuration Values

- **Speed:** LDW activation speed. Above this threshold, KP2 will generate LDW events. This value ranges from 40 kph/25 mph to 160 kph/100 mph.
- **Left & Right line Sensitivity:** AI level of confidence that line detection is a solid lane line. This 1-5 scale allows you to scale the number of events your device triggers.

LDW Sensitivity Level				
1	2	3	4	5
Fewer events (lower line detection sensitivity)		Recommended		More events (higher line detection sensitivity)

- **Speaker:** Enables in-cabin alerts. Sound type settings are determined in the configuration tool (**Info > Service > Voice Type**).
- **Detect Interval:** A period of time that represents a single event during which the device will disregard repeated LDW instances. For example, if the detect interval is set to 10 seconds, an LDW event cannot be followed by another one for at least 10 seconds.

Note: LDW lane detection does not incorporate color recognition.

6 AP1 Event Logic

AP1's ADAS capabilities rely upon customizable event sensitivities to determine its detection, in-cabin alerts and the volume of events triggered. Review the sections featured below to learn more. Resellers who need assistance should contact Support.

6.1 HMW

Detection Conditions

- HMW activates for vehicle speeds over 30 kph/19 mph.
- AP1 measures TTC (time to collision) via the device's ADAS library. It is based on vehicle speed and the perceived distance between the driver's vehicle and the vehicle ahead. Variations in speed and distance dictate the TTC times at different severities (most = level 1, least = level 5).

Configuration Values

- **Sensitivity:** This dictates different detection parameters like TTC (Time to Collision) and distance. Generally, the higher the setting, the earlier the delivery of the alert.
- **Repeat:** This allows for consecutive alerts on the same vehicle ahead in incident-prone scenarios.
- **Re-Alert:** This allows for consecutive alerts whenever they occur, regardless of the vehicle ahead.

HMW Sensitivity Level (Time to Collision)				
Level 1	Level 2	Level 3	Level 4	Level 5
0.6 sec	0.9 sec	1.2 sec	1.5 sec	2.0 sec

HMW Sound Type					
0	1	2	3	4	5
Mute	Beep 1	Beep 2	Beep 3	Male Voice	Female Voice

6.2 FCW

Detection Conditions

- FCW activates when vehicle speed is over 30 kph/19 mph. The minimum speed when GPS is the ADAS speed source is 60 kph/37 mph.
- AP1 measures TTC (time to collision) via the device's ADAS library. It's based on vehicle speed and the perceived distance between the driver's vehicle and the vehicle ahead. Variations in speed and distance dictate the TTC times at different severities (most = level 1, least = level 5).

Configuration Values

- **Enable:** Activates FCW.
- **Sensitivity:** This dictates different detection parameters like TTC (Time to Collision) and distance. Generally, the higher the setting, the earlier the delivery of the alert.
- **Repeat:** This allows for consecutive alerts on the same vehicle ahead in incident-prone scenarios.
- **Record:** Event footage recorded when FCW is triggered.

FCW Sensitivity Level (Time to Collision)				
Level 1	Level 2	Level 3	Level 4	Level 5
2.2 sec	2.4 sec	2.6 sec	2.8 sec	3.0 sec

*TTC example based on 72 kph. Please note that FCW TTC adjusts according to vehicle speed and distances.

FCW Sound Type					
0	1	2	3	4	5
Mute	Beep 1	Beep 2	Beep 3	Male Voice	Female Voice

6.3 LDW

Detection Conditions

- Only solid lane lanes are recognized.
- LDW operates within a speed range of 40 to 80 kph/25 to 50 mph.

Configuration Values

- **Enable:** Activates LDW.
- **Activation Speed:** Configure your speed threshold within the operational range.
- **Sensitivity:** This monitors the distance to and from the lane line. Detection responsiveness generally increases as sensitivity is raised. You can set up different sensitivity levels for either direction (left or right). See figure 4 below for visual guidance (not to scale).

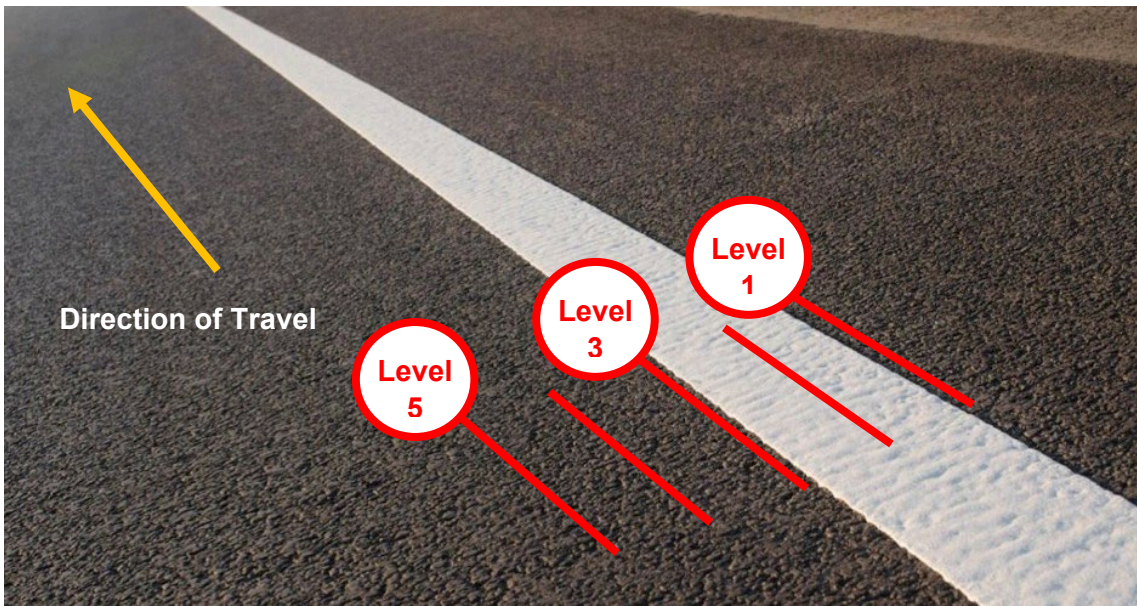


Figure 4

LDW Sensitivity (Distance from the Wheel to Lane)				
Level 1	Level 2	Level 3	Level 4	Level 5
+ 20cm	+ 10cm	+ 0cm	- 10cm	- 20cm

LDW Sound Type				
0	1	2	3	4
Mute	Beep 1	Beep 2	Female Voice	

7 Frequently Asked Questions

Q: What is the standard ADAS configuration for AP1 and KP2?

A: For both devices, ADAS is disabled by default.

Q: How do I adjust event sensitivity or speed thresholds?

A: The best way to customize your configuration is through the configuration tools. Some event types on each device have explicit sensitivity settings; however, in some cases, sensitivity has a different function or relies upon speed and distance settings to measure the conditions that trigger an event. Review each device's event detection parameters to establish thresholds applicable to you or your end customer's specific use cases. If you are unaware of how to push settings.ini files to your device OTA (over-the-air), follow the instructions outlined [here](#). Although unmentioned in this document, the same process still applies for AP1 and KP2.

Q: I have devices that support ADAS, but it does not appear to be working properly.

A: There may be several reasons you are not receiving ADAS events. Below are a few common reasons ADAS events do not appear in your web application or user interface.

- AP1 and KP2 have master enable/disable parameters for all ADAS functions, accessible in the Configuration tools. For AP1, it is the "ADAS" field in the **Device/Vehicle** tab. For KP2, it appears as the "Use" field in **Event > ADAS**. Ensure these are activated appropriately to allow your device to digest event data.
- Device notification settings are not enabled. In both devices' configuration tools, go to **Server > Event Triggered By**, and enable the appropriate event notifications sent from the device. These must be activated for your device to send event notifications to SmartAPI.
- Event notifications are deactivated in your tenant. ADAS event types are enabled on the device (either through the configuration tool or the mobile application) but not activated for your SmartAPI tenant in the Workstation. Your device may still transmit ADAS events to the platform, but your callback listener will not receive notifications.

If you continue to have trouble with enablement, contact your integration team through email or your designated Teams channel to resolve these issues or any other matter relating to ADAS enablement. INSIGHTS resellers may also contact support for assistance.

Q: Are there different event types for base & LV2 in KP2 Events?

A: Lv1 and Lv2 events are the same type but have different content in the event message. See the **Event Triggered By** section in the configuration tool's **Server** tab.

Q: What is the difference between HMW and FCW?

A: The difference springs from the difference in speed between the device's host vehicle and the vehicle ahead when they are spaced closely. When this speed difference is negligible there is no risk of collision, but there is a possibility of an HMW event. FCW applies when the host vehicle is getting consistently closer to the vehicle ahead (a meaningful speed difference), such that a collision is imminent if speeds remain the same.

8 Appendix A

Sample code of an ADAS event message.

```
{
  "EventLogID":"e352bbee-b21d-44e4-ac57-ab16fa7fd686",
  "AlarmIn":null,
  "Altitude":230,
  "DeviceID":"cdf01492-8e9a-4376-899a-adb200fa1ff2",
  "DeviceStatus":null,
  "EventData":null,
  "EventTime":"2021-10-22T17:15:02.0040000Z",
  "EventType":"ADAS",
  "GPSValid":false,
  "Heading":269.70001220703125,
  "IgnitionOn":true,
  "Latitude":39.92666608,
  "Longitude":-86.19962397,
  "MoreInfo":{"
    "ADAS":"LDW"
  },
  "RecorderID":"867927040553923",
  "RequestID":null,
  "Speed":66,
  "SpeedLimit":0,
  "TSPSerialNumber":"",
  "DataURLs":null,
  "GPSExtraInfo":null,
  "MediaURLs":null
}
```

9 Appendix B

Sample code of a ManualBackup message.

```
{
  "EventLogID":"9ce6f731-38d2-43d2-a276-0c7e5f16a65c",
  "AlarmIn":null,
  "Altitude":229,
  "DeviceID":"cdf01492-8e9a-4376-899a-adb200fa1ff2",
  "DeviceStatus":null,
  "EventData":null,
  "EventTime":"2021-10-22T17:13:35.0040000Z",
  "EventType":"ManualBackup",
  "GPSValid":false,
  "Heading":1.2000000476837158,
  "IgnitionOn":true,
  "Latitude":39.92630658,
  "Longitude":-86.18396766,
  "MoreInfo":{
  "ADAS":"FCW",
  "OriginalEventType":"ADAS"
},
  "RecorderID":"867927040553923",
  "RequestID":"9ce6f731-38d2-43d2-a276-0c7e5f16a65c",
  "Speed":36,
  "SpeedLimit":0,
  "TSPSerialNumber": "",
  "GPSExtraInfo":null,
  "MediaURLs":[
  {
    "Camera":0,
    "Altitude":0,
    "ContentSize":12760718,
    "EndDateTime":"2021-10-22T17:13:46.0000000Z",
    "FileFormat":3,
    "Heading":0,
    "Latitude":0,
    "Longitude":0,
    "MDTURL":"/SmartWitness/RecorderService/GetDataFile/66a3e26c-20be-4420-9a55-
      a59500d00fd8/867927040553923/2021/10/22/MMV/42ab99ed-af4d-4947-a8ca- 2f959f714887.0.mmv",
    "Speed":0,
    "StartDateTime":"2021-10-22T17:13:26.0000000Z",
    "URL":"/SmartWitness/RecorderService/GetDataFile/66a3e26c-20be-4420-9a55-
      a59500d00fd8/867927040553923/2021/10/22/MP4/d2d9c5b3-c69c-43b0-b4da-
      c26391e02dc3.0.mp4"
  }
  ]
}
```