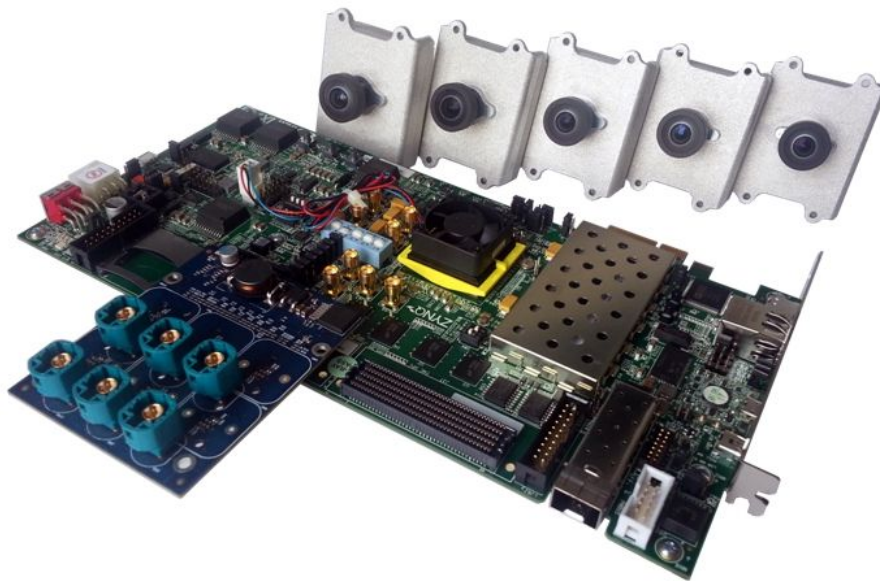


## Xylon d.o.o.

Fallerovo setaliste 22  
10000 Zagreb, Croatia  
Phone: +385 1 368 00 26  
Fax: +385 1 365 51 67  
E-mail: [support@logicbricks.com](mailto:support@logicbricks.com)  
URL: [www.logicbricks.com](http://www.logicbricks.com)



**Figure 1: The logiADAK Zynq-7000 AP SoC Automotive Driver Assistance Kit**

## Features

- Full design framework for real-time vision-based Advanced Driver Assistance Systems (ADAS)
- Based on the Xilinx® Zynq®-7000 All Programmable System on Chip (SoC)
- Includes Driver Assistance (DA) demos:
  - logiOWL Vehicle Self Calibration – quick and effortless automated system calibration
  - 360° Surround View (3D and bird's eye views)
  - Driver Drowsiness Detection
  - Forward Looking Collision Avoidance with the Range Estimation (Vehicles/Pedestrians/Bikes)
  - Rear-View Camera (several modes)
  - Lane Departure Warning (LDW)
  - Blind Spots Detection
- Some demos are production-ready and used in automotive production systems of today
- All-in-one hardware platform is appropriate for test vehicle installations
- Includes advanced software to enable quick setup on any vehicle:
  - logiADAK Builder for viewing modes setup
  - logiVCS visual configuration system
  - Calibration applications for different demos
  - logiSTK training tool for object detectors (Trial)
- Kit users can change demo views, add logo, etc. through the included software tools, and change the application software at the source code level
- Can be upgraded with the logiADAK-VDF Video Framework and customized at the SoC level
- Xylon offers design services for user specific platform customizations, i.e. change cameras
- 25 hours of tech support (e-mail)

## Applications

- Surround View (3D views and Bird's Eye View), Driver Drowsiness Detection, Pedestrian Detection, Vehicle Detection, Bikes/Motorbikes Detection, Rear-View Camera, Lane Departure Warning, Blind Spot Detection, and other emerging video-based ADAS
- Surveillance (360° Panoramic Camera), aerospace and defense, test and measurement equipment...

## General Description

The logiADAK Automotive Driver Assistance kit is Xilinx Zynq-7000 All Programmable System on a Chip (SoC) based development platform for Advanced Driver Assistance (ADAS) applications that require intensive real-time video processing, parallel execution of multiple complex algorithms, and flexible interfacing with sensors and vehicle's communication backbones.

The logiADAK kit is used to quickly bring new ADAS innovations to market. It provides ADAS designers all the resources they need to efficiently develop vision-based ADAS systems, save months of development time and focus efforts on system differentiating functions and performance. The kit comes with a full set of user customizable demo applications, advanced software for quick setup on any vehicle, documentation and skilled Xylon technical support. The provided logiADAK hardware platform is appropriate for quick test vehicle installations and rapid engagements in proof-of-concept or demonstration projects

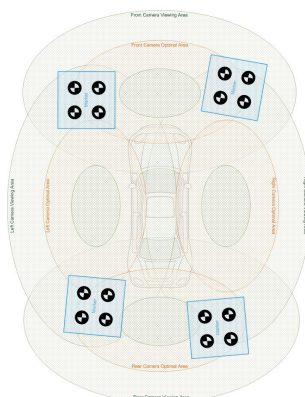
The included ADAS demos use several Zynq-7000 AP SoC designs to reprogram the Programmable Logic (PL) and support different feature bundles suitable for different driving conditions. This ultimate re-programmability, which occurs under the continued supervision of the ARM® Cortex™-A9 processors in the Processor System (PS), saves silicon resources and enables use of smaller and more cost efficient Zynq-7000 SoC.

The logiADAK can be upgraded with the logiADAK-VDF Video Design Framework that includes two complete and licensed camera-to-display SoC designs and enables quick utilization of the provided hardware platform by the end user. Instead of starting from scratch, the logiADAK-VDF framework users can immediately focus on specific vision-based parts of their next SoC design for ADAS. Since the logiADAK hardware platform enables test vehicle installations, the new ADAS developments can be quickly tested and validated on the road.

## logiADAK Demo ADAS Applications

The included demo applications can be evaluated on real vehicles, changed by end users (i.e. change views, add user logo, and similar), merged with user's innovation and efficiently developed into products.

### logiOWL Vehicle Self Calibration



logiOWL\* enables automatic end of line camera calibration. It runs fully embedded in the vehicle and enables full vehicle level multi-camera calibration in as little as 10 seconds. The process is simple and inexpensive, does not require a complex calibration site, and can be executed easily in repair shops without specialized training for service personal.

\* Filled patent application

**Figure 2: logiOWL markers setup example**

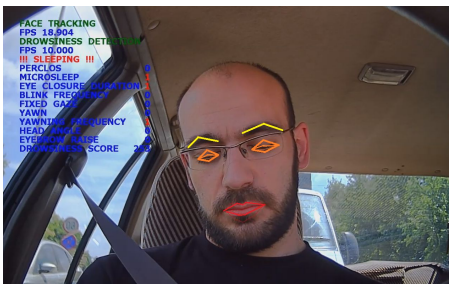
### 360° 3D Surround View



The Surround View (SV) parking assistance enables the driver to see 360° surroundings around the vehicle from different perspectives, including 3D visualized views from the programmable point of view and the top-down bird's eye view perspective. Such views eliminate all blind spots during critical and precise maneuvers in different traffic situations. The logiADAK deliverables include the full four-camera SV setup. For more information about the six-camera SV setup suitable for larger vehicles including commercial trucks, please contact Xylon.

**Figure 3: 3D Surround View**

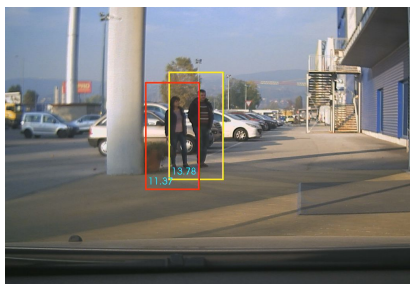
### Driver Drowsiness Detection



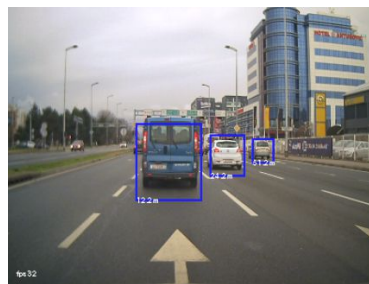
Impaired driving skills of sleepy drivers have been one of the major accident causes and can lead to severe physical injuries, deaths and significant economic losses. The drowsiness detector detects drowsiness and distraction based on facial movements monitored through a camera placed in a vehicle cabin. It monitors movements of driver's eyes, gaze, eyebrows, lips and head, and continuously tracks several facial behavioral features indicating the drowsiness.

**Figure 4: Driver Drowsiness Detection**

### Multi-Object Detection and Range Estimation



**Figure 5: Pedestrian Detection**



**Figure 6: Vehicle Detection**

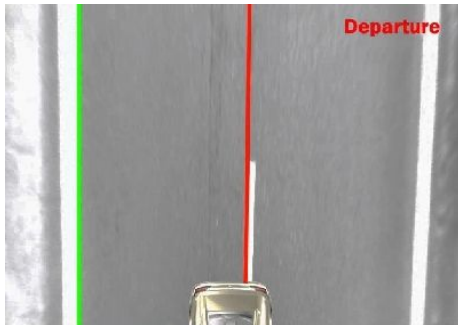


**Figure 7: Bikes Detection**

Multi-Object Detection (Pedestrians/Bikes/Vehicles) with tracking capability for forward camera collision avoidance alerts the driver in case of detected persons and/or objects in the area surrounding the vehicle along the moving direction. The level of warning is based on the estimated distance range.



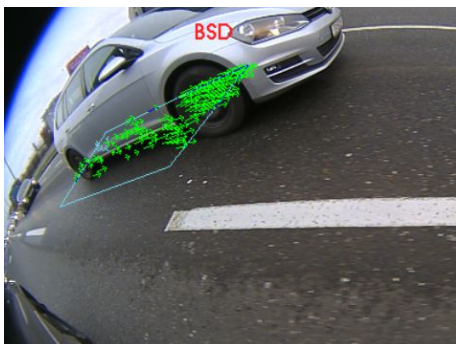
## Rear-Looking Lane Departure Warning



Lane Departure Warning (LDW) ADAS track the markings corresponding to the lane boundaries, locate the vehicle position with respect to them and issue a warning when the vehicle crosses the lane borders. The Rear Looking Lane Departure Warning systems work with a common back-up camera typically used for Rear-View applications with no need for additional camera sensors.

**Figure 8: Lane Departure Warning**

## Blind Spots Detection

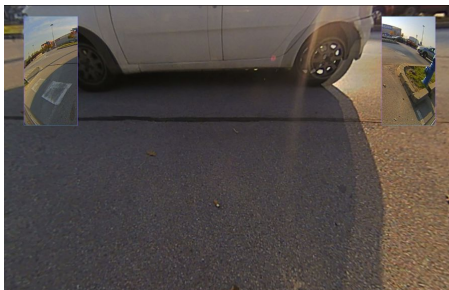


The Blind Spot Detection collision avoidance DA uses side-view cameras to provide a driver with information about objects that are outside his/her range of vision – in the blind spots (areas) to both sides of a vehicle. The system is able to detect the presence of objects in the blind spots and inform the driver about it.

*The key IP cores and software for the Blind Spots Detection applications are sourced from Digital Design Corporation (DDC).*

**Figure 9: Blind Spots Detection**

## Rear-View Camera



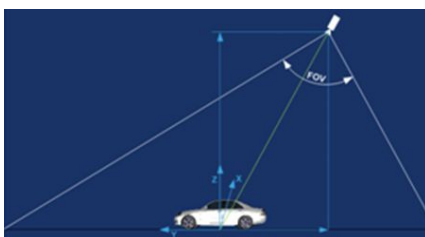
Rear-view camera removes the rear blind spots and helps in backing up. Xylon demo setup includes a wide array of customizable viewing modes, including Picture-in-Picture modes like the Rear Cross path indicator.

**Figure 10: Rear-View Camera**

## logiADAK Advanced Software

The logiADAK kit deliverables include advanced software for fine tunings by end users: camera system calibrations, viewing modes setup, collision avoidance features training, etc.

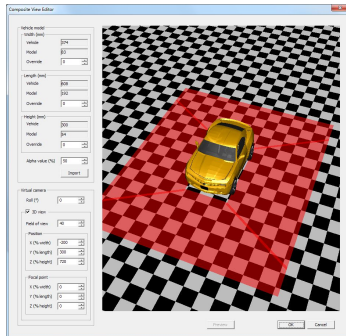
## Demo Calibration Software



The body shape and size of different vehicles dictate the camera installation points and each vehicle requires a unique setup of the system. The logiADAK kit includes calibration software for: Surround View, Objects Detection, Rear-Looking Lane Departure Warning, and Blind Spot Detection applications.

**Figure 14: Choose and alter many calibration parameters**

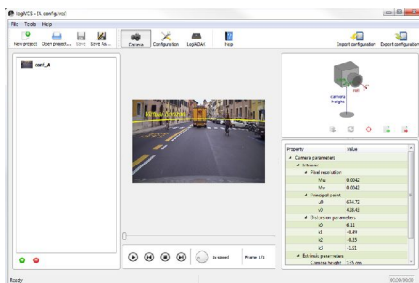
## logiADAK Builder



The logiADAK Builder implements a convenient PC user interface towards the target ADAS system embedded in a vehicle. It enables quick customizations of the Surround View system features, modes and mode views. All previews are done on the target and there is no mismatch between the PC settings and the final target system settings. Required vehicle calibration data and customized views must be setup once for the specific vehicle model. In combination with the logiOWL Vehicle Self Calibration, the determined setup enables quick and precise vehicle self-calibration suitable for volume production.

**Figure 11: logiADAK Builder example**

## logiVCS Visual Configuration System



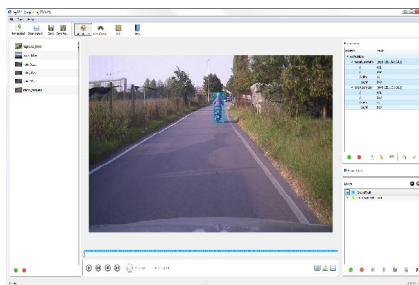
The logiVCS is a software tool for simple configuration of object detectors (logiHOG and logiVDET IP cores) in the logiADAK kit. It calibrates the camera and automatically computes ROIs (Region of interest) of camera frames where the tracked objects can be found. The logiVCS takes trained classifiers from the logiSTK software training kit, enables user to tune object tracking parameters, and imports/exports object detectors configurations in the logiADAK kit.

**Figure 13: logiVCS Screenshot**

Download for free:

<http://www.logicbricks.com/Solutions/Xylon-ADAS-Development-Kit/Software-Downloads.aspx>

## logiSTK Software Training Kit (TRIAL)



The logiSTK is a software tool for training and testing HOG/SVM-based classifiers used for multi-objects detections. The logiADAK kit comes with the system trained to recognize pedestrians, bikes and vehicles. However, the system can be trained and tested to recognize other objects, even by the users who are not vision experts. Determined object classifiers can be exported to the logiADAK HW kit.

**Figure 12: logiSTK Screenshot**

Download 15-days trial version:

<http://www.logicbricks.com/Solutions/Xylon-ADAS-Development-Kit/Software-Downloads.aspx>

## Xilinx Zynq-7000 AP SoC Designs

ADAS demos are provided via three Xilinx Zynq-7000 All Programmable SoC configuration designs, which are used for different ADAS applications in different driving conditions. Depending on the vehicle's velocity, the Xilinx Zynq-7000 AP SoC programmable logic can be configured with a different set of custom hardware accelerators. Xylon provides the SoC designs in the binary configuration format.

**Low-Velocity Driving Applications Set:**

- logiOWL Vehicle Self Calibration – quick and effortless automated system calibration
- 360° Surround View: 3D viewing modes and bird's eye viewing mode
- Pedestrian Detection and Range Estimation
- Rear-View Camera: uncorrected video, distortion correct view, trailer-hitch mode, cross path mode ...

**High-Velocity Driving Applications Set:**

- Pedestrians/Bikes/Vehicle Detections and Range Estimation
- Lane Departure Warning (using rear-view camera)
- Blind Spots Detection (using side-view cameras)

**In-Cabin Set:**

- Driver Drowsiness Detection (using the 5<sup>th</sup> camera)



Xylon offers assistance and technical support for the Xilinx partial reconfiguration that enables exchange of custom hardware accelerators in programmable logic while the SoC device works in an uninterrupted fashion. The partial reconfiguration allows the use of smaller SoC devices with several sets of hardware accelerators for different ADAS applications and driving conditions. For more information, please contact Xylon at [info@logicbricks.com](mailto:info@logicbricks.com).

To see block diagrams of the demo SoC designs included with the kit, please visit:

<http://www.logicbricks.com/Solutions/Xylon-ADAS-Development-Kit/logiADAK-Reference-SoC-Designs.aspx>

**Key IP Cores**

The logiADAK SoC designs are implemented by the following IP cores from Xylon and partners:

**logiVIEW Perspective Transformation and Lens Correction Image Processor**

Removes fish eye lens distortions, makes perspective corrections to all camera video inputs, executes video texturing on curved surfaces and stitches the resulting single image in a real-time.

Find more information by visiting: [www.logicbricks.com/Products/logiVIEW.aspx](http://www.logicbricks.com/Products/logiVIEW.aspx).

Get the datasheet: [http://www.logicbricks.com/Documentation/Datasheets/IP/logiVIEW\\_hds.pdf](http://www.logicbricks.com/Documentation/Datasheets/IP/logiVIEW_hds.pdf).

**logiHOG Object Detector**

The logiHOG is an HOG/SVM-based object detection logicBRICKS IP core for detection of multiple objects in vision-based embedded applications. It is a direct successor of the logiPDET Pedestrian Detector IP core. The algorithm follows a discriminative approach by combining the HOG-based descriptor and the SVM classifier.

Find more information by visiting: [www.logicbricks.com/Products/logiHOG.aspx](http://www.logicbricks.com/Products/logiHOG.aspx).

Get the datasheet: [http://www.logicbricks.com/Documentation/Datasheets/IP/logiHOG\\_hds.pdf](http://www.logicbricks.com/Documentation/Datasheets/IP/logiHOG_hds.pdf).

**logiVDET Vehicle Detector**

The logiVDET is a learning-based vehicle detection IP core, developed for vision-based embedded applications. The algorithm follows a discriminative approach based on a cascaded classifier using Local Binary Pattern

features. This architecture makes the detection process faster by rejecting the negative examples in the initial stages of the cascade, while the computation effort is mainly spent on the templates hard to classify.

Find more information by visiting: [www.logicbricks.com/Products/logiVDET.aspx](http://www.logicbricks.com/Products/logiVDET.aspx).

Get the datasheet: [http://www.logicbricks.com/Documentation/Datasheets/IP/logiVDET\\_hds.pdf](http://www.logicbricks.com/Documentation/Datasheets/IP/logiVDET_hds.pdf).

### **logiLMD Lane Marking Detector**

Detects the lane markings on the roadway captured from a rear view camera. Its functions include image-processing filters, like Gaussian smoothing and Edge detection, and blocks specifically tailored for lane marking detections. The output of the core is a set of straight lines corresponding to the lane markings.

Find more information by visiting <http://www.logicbricks.com/Products/logiLMD.aspx>.

Get the datasheet: [http://www.logicbricks.com/Documentation/Datasheets/IP/logiLMD\\_hds.pdf](http://www.logicbricks.com/Documentation/Datasheets/IP/logiLMD_hds.pdf).

### **logiDROWSINE Driver Drowsiness Detector**

Detects levels of driver's drowsiness based on facial movements monitored through a camera. The IP core monitors movements of driver's eyes, gaze, eyebrows, lips and head, and continuously tracks nine facial behavioral features that indicate the drowsiness: PERCLOS, microsleep, yawn and others.

Find more information by visiting <http://www.logicbricks.com/Products/logiDROWSINE.aspx>.

Get the datasheet: [http://www.logicbricks.com/Documentation/Datasheets/IP/logiDROWSINE\\_hds.pdf](http://www.logicbricks.com/Documentation/Datasheets/IP/logiDROWSINE_hds.pdf).

### **logiWIN Versatile Video Input**

Video frame grabber that accepts a streaming video input, decodes it, and converts into the RGB format. The input video can be real-time scaled, de-interlaced, cropped and positioned on the video display. The logiWIN integrates high-quality anti-aliasing algorithm that guarantees high picture quality without visible artifacts.

Find more information by visiting [www.logicbricks.com/Products/logiWIN.aspx](http://www.logicbricks.com/Products/logiWIN.aspx).

Get the datasheet: [http://www.logicbricks.com/Documentation/Datasheets/IP/logiWIN\\_hds.pdf](http://www.logicbricks.com/Documentation/Datasheets/IP/logiWIN_hds.pdf).

### **logiCVC-ML Compact Multilayer Video Controller**

An advanced display graphics controller for LCD, which enables an easy video and graphics integration into embedded systems with Xilinx All Programmable devices. Provides flexible display control, with resolutions up to 2048x2048 pixels, and includes a level of hardware acceleration: alpha blending, panning, buffering of multiple frames, etc.

Find more information by visiting [www.logicbricks.com/Products/logiCVC-ML.aspx](http://www.logicbricks.com/Products/logiCVC-ML.aspx).

Get the datasheet: [http://www.logicbricks.com/Documentation/Datasheets/IP/logiCVC-ML\\_hds.pdf](http://www.logicbricks.com/Documentation/Datasheets/IP/logiCVC-ML_hds.pdf).

### **BSD Blind Spot Detection using optical flow motion estimation**

The optical flow field is used to estimate the 2D motion projected on the image plane by the objects moving in the 3D scene. Graphical representation of the optical flow vectors is through the use of overlays on the original image. The Zynq SoC Processing System (PS) is used to analyze statistics of the vectors in user defined blind spot regions and to determine if there is a valid detected object. The BSD IP cores and software for the Blind Spots Detection applications are sourced from Digital Design Corporation (DDC).

For more information about the BSD, please contact DDC (<http://www.digidescorp.com/>).

### **logiOWL Vehicle Self Calibration and the logiADAK Builder**

A set of Xylon IP cores and related software enables automatic end of line calibration. While traditional electronic means of alignment are challenging, time consuming and require specialized calibration environments, Xylon's end of line calibration solution runs fully embedded in the vehicle and takes only seconds



for full multi-camera calibration. The solution is precise, simple and inexpensive and does not require a complex calibration site.

The logiOWL Vehicle Self Calibration runs fully and autonomously on the target ADAS system. The logiADAK Builder provides an optional and convenient user interface via Ethernet to enable customizations of viewing modes used in the embedded target ADAS system.

For more information about the logiOWL, please contact Xylon at [info@logicbricks.com](mailto:info@logicbricks.com).



logiADAK kit users can purchase the logiADAK-VDF Video Design Framework and quickly utilize the logiADAK hardware platform for their own ADAS SoC developments. The framework includes two complete camera-to-display SoC designs (included logicBRICKS IP cores licensed for prototyping) that use just a fraction of available programmable logic, significantly saves the design time and allows users to focus on their own ADAS innovation.

Find more information by visiting <http://www.logicbricks.com/Products/logiADAK-VDF.aspx>.

Datasheet: [http://www.logicbricks.com/Documentation/Datasheets/IP/logiADAK-VDF\\_hds.pdf](http://www.logicbricks.com/Documentation/Datasheets/IP/logiADAK-VDF_hds.pdf).

## logiADAK Hardware Platform

The logiADAK hardware platform includes the Xilinx Zynq-7000 SoC ZC706 development board, the FMC add-on board for connections of up to 6 HD video cameras, five Xylon video cameras, and a full cabling set. Camera systems in weather-proof (IP65) aluminum housing are designed by Xylon and include OmniVision OV10635 1-megapixel HDR camera sensor (1280x800p30 WXGA (HD)), LVDS transmitter board and the appropriate lens.

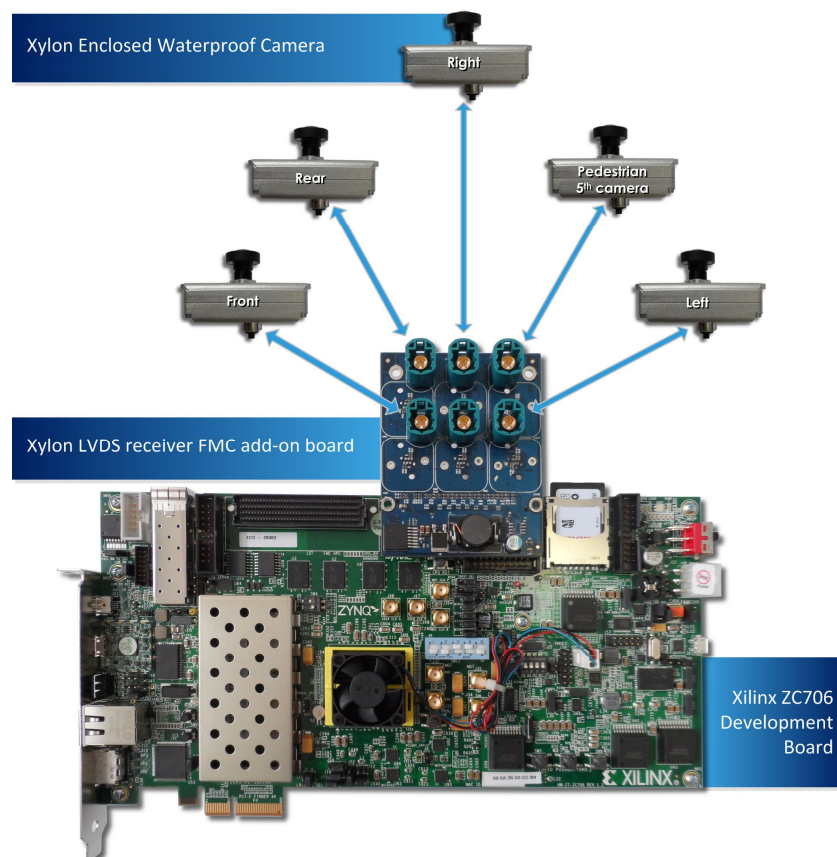


Figure 15: The logiADAK Kit Hardware Platform – System Connections



## Package Content

### Hardware

- 1x Xilinx Zynq-7000 SoC ZC706 Development Kit<sup>1</sup> with XC7Z045 FFG900 -2 AP SoC
- 1x Xylon LVDS receiver FMC add-on daughter card for up to 6 camera connections (ZC706 side)
- 5x Xylon Enclosed Camera Systems (each system contains the Xylon LVDS serializer board for camera sensors, OmniVision OV10635 1Mpix camera sensor, 4x Sunex DSL219 and 1x DSL947<sup>3</sup> miniature lenses and weather-proof (IP65) aluminum camera housing designed by Xylon)
- 4x Vehicle Calibration Carpets<sup>2</sup> and 4x Model-Sized Calibration Carpets (for use on lab desks)
- 1x SD card
- 1x USB memory stick with software deliverables

<sup>1</sup> OEM kit version, does not include cables, SD card and software (seat Vivado Design Suite)

<sup>2</sup> Internationally registered industrial design

<sup>3</sup> Narrow FOV lens used for the 5<sup>th</sup> camera: collision avoidance and driver drowsiness detection. Other lenses are Wide FOV.

### Zynq-7000 AP SoC Designs

The reference SoC designs are prepared using Xilinx Vivado tools, version 2015.4 and delivered in the binary configuration format.

### Applications and Drivers

- Demo applications in source code
- logiADAK Builder
- logiVCS Visual Configuration System
- Trial Version of the logiSTK Software Training Kit
- logicBRICKS standalone (bare-metal) and Linux drivers with examples
- Zynq-7000 AP SoC FSBL sources
- Xylon precompiled utility libraries

### Documentation

- logiADAK User's Manual
- logiADAK Low-Velocity Application User's Manual
- logiADAK High-Velocity Application User's Manual
- logiADAK Vehicle Setup Guidelines
- Multiple Objects Detection Calibration and Setup User's Manual
- Blind Spot Detection User's Manual (DDC)
- RLDW Calibration and Setup User's Manual
- logicBRICKS User's Manuals

### Cabling and Adapters

- power supply
- 5x long cables for camera interfacing; suitable for vehicle installations

## Recommended Design Experience

The users, who want to make changes on the provided designs, should have experience in the following areas:

- Xilinx design tools
- C programming

## Design Services

Design services are available to customers interested in customization and enhancement developments based on the presented hardware and software products. Xylon can change all parts of the logiADAK kit in order to adopt it to specific customer's requirements.

## Related Xylon Products

logiADAK kit users can purchase the logiADAK-VDF Video Design Framework and quickly utilize the logiADAK hardware platform for their own ADAS SoC developments. The framework includes two complete camera-to-display SoC designs (included logicBRICKS IP cores licensed for prototyping) that use just a fraction of available programmable logic, significantly saves the design time and allows users to focus on their own ADAS innovation:

Email: [support@logicbricks.com](mailto:support@logicbricks.com)  
URL: <http://www.logicbricks.com/Products/logiADAK-VDF.aspx>

The logiRECORDER Multi-Channel Video Recording Advanced Driver Assistance (ADAS) Kit builds on the logiADAK Automotive Driver Assistance kit by including all necessary hardware and software for synchronous video recording and playback of up to six (6) uncompressed video streams from Xylon video cameras. The recorded videos include important video metadata collected from the vehicle's On-Board Diagnostic OBD-II bus and an external GPS module: timestamps, vehicle GPS position, speed and others. The kit can be integrated in test vehicles for video recordings of real-world driving conditions and situations for use in lab environments.

Email: [support@logicbricks.com](mailto:support@logicbricks.com)  
URL: <http://www.logicbricks.com/Products/logiRECORDER-BASE.aspx>

Computer vision applications (including ADAS) require quality video input. Xylon's logiISP Image Signal Processing Pipeline IP core is the Ultra-High Definition (UHD, including 4K2K) High-Dynamic Range (HDR) ISP pipeline designed for digital processing and image quality enhancements of an input video stream in Smarter Vision embedded designs based on Xilinx Zynq-7000 All Programmable SoC, 7 Series and newer FPGA/SoC devices. Learn more about this IP core:

Email: [support@logicbricks.com](mailto:support@logicbricks.com)  
URL: <http://www.logicbricks.com/Products/logiISP.aspx>

## Ordering Information

This product is available directly from Xylon. Please visit our web shop or contact Xylon for pricing and additional information:

Email: [sales@logicbricks.com](mailto:sales@logicbricks.com)  
URL: <http://www.logicbricks.com/Products/logiADAK.aspx>

This publication has been carefully checked for accuracy. However, Xylon does not assume any responsibility for the contents or use of any product described herein. Xylon reserves the right to make any changes to product without further notice. Our customers should ensure that they take appropriate action so that their use of our products does not infringe upon any patents. Xylon products are not intended for use in the life support applications. Use of the Xylon products in such appliances is prohibited without written Xylon approval.

## Related Information

### Xilinx Programmable Logic

For information on Xilinx programmable logic or development system software, contact your local Xilinx sales office, or:

Xilinx, Inc.

2100 Logic Drive  
San Jose, CA 95124  
Phone: +1 408-559-7778  
Fax: +1 408-559-7114  
URL: [www.xilinx.com](http://www.xilinx.com)

## Revision History

| Version | Date        | Note   |
|---------|-------------|--|
| 1.00    | 17.12.2012  | Initial release.   |
| 2.00    | 15.02.2013  | The first public release.<br>Kit updated with the Blind Spots Detection using side-view cameras.   |
| 2.00    | 23.10.2013  | BSD IP core name changed, Xilinx tools version set to 14.6.  |
| 2.01    | 23.09.2014  | Increased rev. to match release rev.   |
| 3.0     | 05.02.2015. | logiOWL, logiADAK Builder, Face Detection and Tracking, upgraded to new board ZC706, camera hot plug and camera lens data stored in camera.  |
| 3.2     | 01.06.2016. | V3.1 not publically released. New features included in this release: multi-object detection with the front camera (pedestrians/bikes/vehicles), driver drowsiness detection, logiSTK software training kit, and logiVCS visual configuration system. |



The logiHOG, logiVDET, logiLMD IP cores, and logiSTK and logiVCS software are sourced from Technology Partner eVS embedded Vision Systems Srl.



visage I SDK™ Face Track tracking engine is sourced from Technology Partner Visage Technologies AB.



The key IP cores and software for the Blind Spots Detection applications are sourced from Digital Design Corporation (DDC).