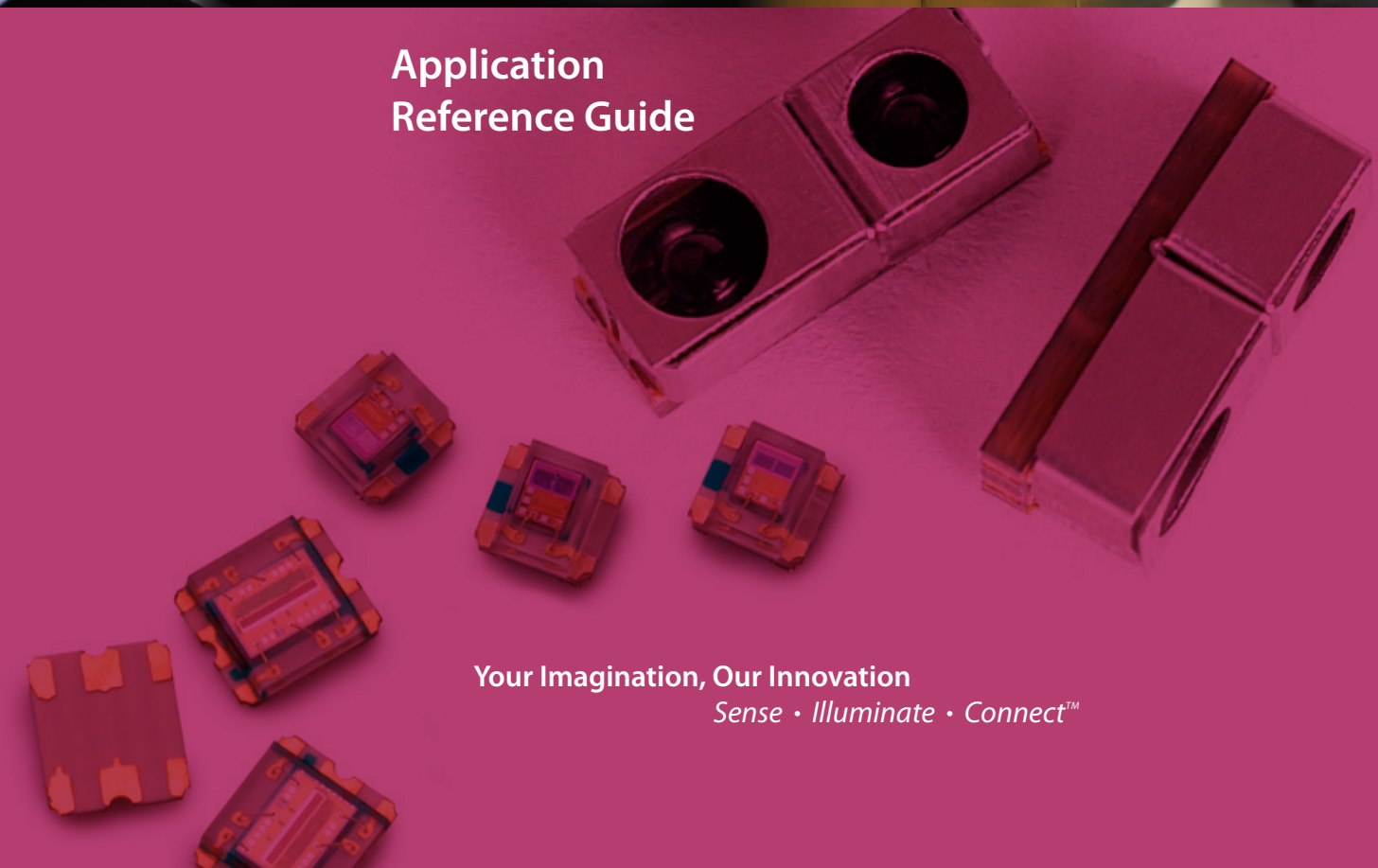
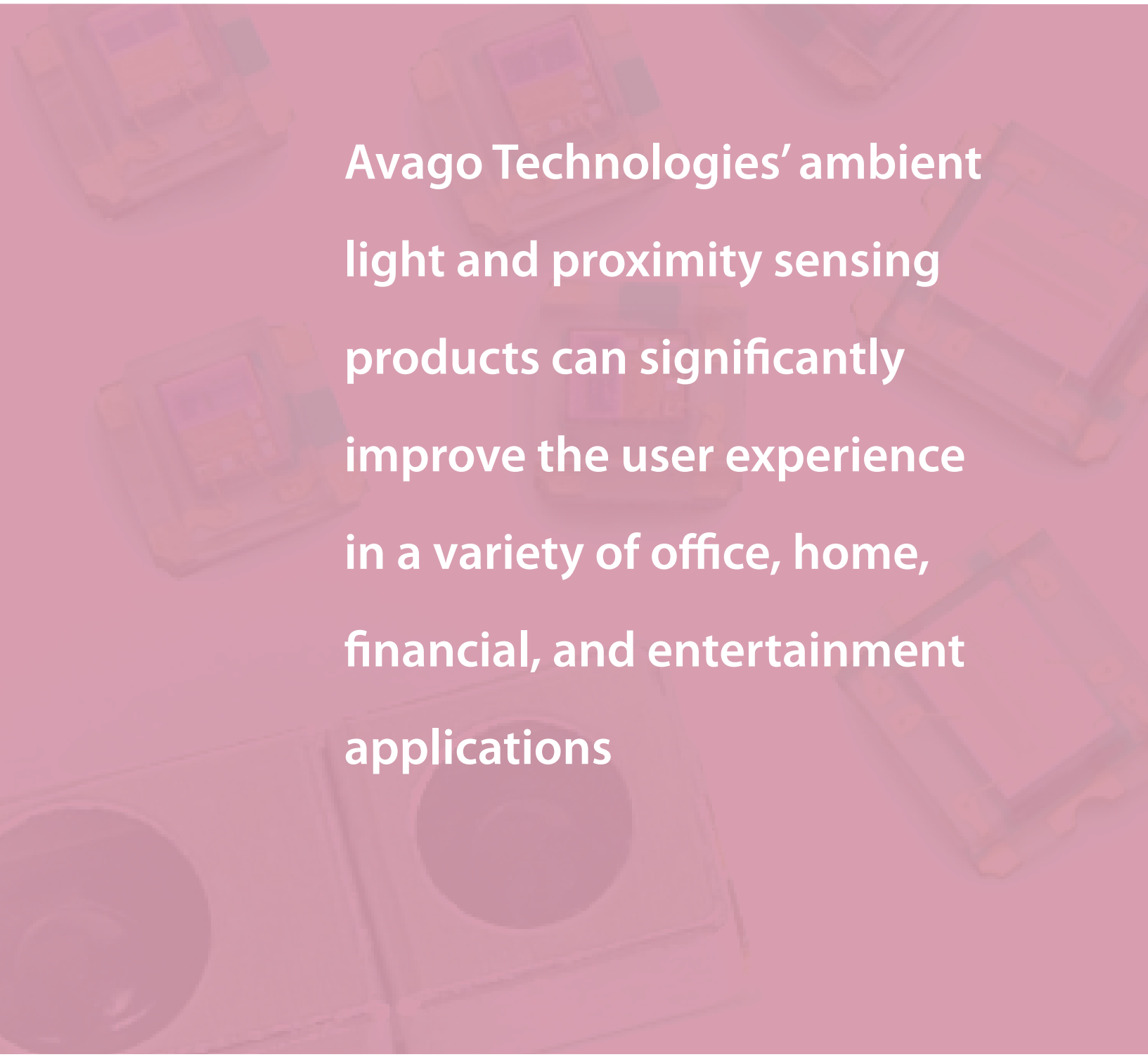
Intelligent Sensing With Ambient Light and Optical Proximity Sensors

Application Reference Guide



Your Imagination, Our Innovation

Sense • Illuminate • Connect™



Avago Technologies' ambient light and proximity sensing products can significantly improve the user experience in a variety of office, home, financial, and entertainment applications

Avago is transforming the modern lifestyle

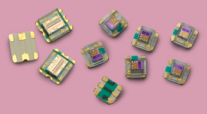
Many development engineers are looking at emerging light sensor applications for their growing design needs. Avago's sensor products provide designers with the optimal solution that offers lower cost and ease of use.

Ambient Light Photo Sensor

- Analog Ambient Light Sensors
- Digital Ambient Light Sensors

Features

- High level of integration that brings faster and more accurate response in ambient light conditions
- Designed to respond closely to the spectral wavelength of the human eye
- Helps to reduce power consumption and conserve battery power in many portable electronic devices
- Automatically adjusts LCD backlight intensity in a variety of applications
- Helps to extend LCD life
- Provides optimum viewing comfort



Proximity Sensors

- Proximity Sensors
- Signal Conditioning IC for Optical Proximity Sensors

Features

- Compact size, suitable for space-constraint applications
- Available in SMD and various packages
- Excellent optical isolation resulting in low optical crosstalk
- Variable detection distances
- Signal conditioning IC (APDS-9700) available as a total solution

Mobile and Computing Devices

The mobile phone has become an indispensable communications component for today's consumers. The use of these phones as informational terminals has increased dramatically. Some of the applications in this mobile computer market segment are ideal for Avago's optical sensing products:

- Mobile handsets, smart phones and PDAs
- Notebooks and Desktop PCs

Proximity sensors automatically turn off the TSP when user brings the phone to the ear

Ambient light detector to adjust brightness of screen and turn on keypad backlighting

Mobile Phone

Automatic Turn-off of Touch Screen Panel

Avago's HSDL-9100 and APDS-91xx proximity sensor provides the intelligence to automatically disable the touch screen panel and turn off the LCD screen to prevent activation of the keys when the phone is in use. The automatic shutdown of the LCD screen will help to conserve power and extend battery life.

The proximity sensor can also be used in the earpiece of handsets to enable automatic call answering.

Avago's APDS-9700 Signal Conditioning IC for PS combines the functionality of signal conditioning for proximity sensing into a single chip to reduce the number of components required. The APDS-9700 also has a shutdown mode that is ideal for use in portable or battery-operated devices. It is used with Avago's proximity sensors as a complete solution.

Speakerphone Activation Proximity Sensor

Placing the HSDL-9100 miniature proximity sensor near the earpiece of the mobile phone provides users with automatic speakerphone activation. When in use, the proximity switch reduces the phone volume when the user places the phone up to their ear. If the user removes the phone from their ear during a conversation, it will revert back to speakerphone mode.

Automatic Screen Brightness Control

Avago's APDS-9005/8 and APDS-9300 (Digital ALS with I2C Interface) ambient light sensors detect environmental lighting changes and automatically adjusts screen brightness and can turn keypad backlighting on and off in mobile phones. This feature helps maximize battery life and extends the lifetime of backlit displays.

Mobile Device Applications

Appliances	Function	Product	Product Recommended
Mobile Devices	Automatic screen brightness adjustment. Keypad backlight ON/OFF	Ambient Light Sensor	APDS-9005, APDS-9008, APDS-9300
	Auto ringer volume sensor	Proximity Sensor	HSDL-9100, APDS-9700, APDS-91xx series
	Speakerphone activation	Proximity Sensor	HSDL-9100, APDS-9700, APDS-91xx series

Notebook and Desktop Applications

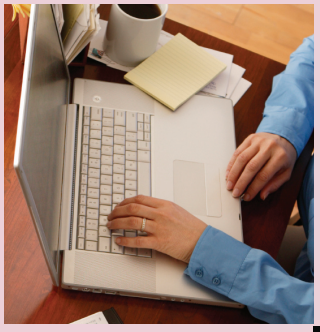
Standby-Mode Activation Sensor

Avago Technologies' miniature HSDL-9100 proximity sensor powers the notebook in standby mode and is an effective replacement for the conventional mechanical switch. The sensor is placed near the edge of the notebook joint so that when the cover is closed the sensor will be triggered -- automatically sending the notebook into sleep mode. Proximity sensors, which can also placed at the front of the keyboard, provides intelligence to activate the computer from standby mode.

Keypad Backlight Standby-Mode Activation Sensor

In dim lighting conditions, proximity sensors automatically turn-off the keypad backlighting when it detects the user is away from the computer. It also reactivates the keypad backlighting when the user's presence is detected. This power-saving feature is also ideal for battery operated devices.

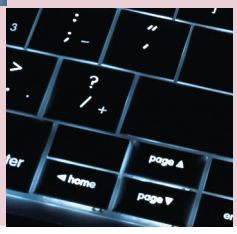
Proximity sensors save battery life of notebooks by sensing if the user is present



Automatic Screen Brightness Adjustment

The typical laptop user spends an average of up to 8 hours per day working on their computer. This extended use can result in eye sight strain and eye fatigue. Other environmental lighting conditions may also compound the problem. As a result, the user is forced to quickly adapt to the changes.

Avago's ambient light sensor adjusts the screen brightness accordingly to minimize eye strain.



Avago's ambient light detector is used to activate keypad lighting

Notebook Applications

Appliances	Function	Product	Product Recommended
Notebook & Display	Automatic screen brightness adjustment	Ambient Light Sensor	APDS-9005, APDS-9006
	Power savings activation for keypad backlighting	Proximity Sensor	HSDL-9100, APDS-9700
Notebook	Keypad back standby-mode activation sensor	Proximity Sensor	HSDL-9100, APDS-9700

Consumer Electronics

Today, more than ever, electronic products are accessible and affordable to more consumers. Avago Technologies provides a wide range of cost-effective performance products for a wide range of consumer products. Some of the applications in this market segment that can benefit from the use of Avago's infrared and sensing products are:

- Digital Cameras
- Televisions
- Headsets
- Game Consoles
- Robotics

Proximity sensor turns off the LCD screen when the user looks through the view finder

Digital Cameras

LCD Screens

Most digital SLR camera's require the pressing of the shuttle button to trigger other functions, such as turning off the LCD screen as the camera gets closer to the eye.

With Avago's HSDL-9100 and APDS-9700 proximity sensor solution, the LCD display will be turned off automatically when the user looks through the viewfinder of the camera. This feature improves user experience by eliminating eye glare from the screen.

Pressure-Free Shuttle Button

Most digital cameras use a pressure shuttle button to trigger the auto-focus function. The user must exert a light pressure on the shuttle button before pressing it fully to take a picture. Users often forget this process and end up taking a photo that turns out blurry.

With the use of Avago's HSDL-9100 near-zero proximity sensor and APDS-9700 signal conditioning IC for proximity sensing, a pressure-free shuttle button can be designed and encapsulated within the button as shown in the illustration. The auto-focus triggers once the user rests their finger on the shuttle button. When ready, the user simply takes the picture.

Digital Camera Applications

Appliances	Function	Product	Product Recommended
Digital Camera	Automatic screen brightness adjustment	Ambient Light Sensor	APDS-9008
	Turning off the LCD display	Proximity Sensor	HSDL-9100, APDS-91XX, APDS-9700
	Autofocus trigger	Proximity Sensor	HSDL-9100, APDS-91XX, APDS-9700

Televisions

Ambient Light Detection

Avago Technologies' ambient light sensor can automatically adjust the brightness of a plasma television screen to suit the viewer's environment

Poor environmental lighting can cause continuous and significant eye strain. The ambient light level can be used to adjust the brightness of television screens.

When mounted on the front panel of a television, Avago's ambient light sensor automatically adjusts screen brightness and contrast according to the lighting environment. This sensor ensures maximum eye comfort and provides a more pleasant visual experience for the user.

Headsets

Headphone User Detection Sensor

Avago's HSDL-9100 miniature proximity sensor is attached on the stem of the "smart" headphone. When the sensor detects the presence of the user's head, the headphone plays music. If the sensor does not detect the user's head, the headphone doesn't turn on. This feature prevents unintentional use and draining of the battery when the "PLAY" button of the audio device is accidentally depressed.

When used on headphones, Avagos' proximity sensor can detect the presence of the user's head to automatically turn on or off

Game Consoles

Automatic Screen Brightness Adjustment

Portable game consoles are so affordable that kids often carry them around wherever they go, regardless of whether there is proper lighting. Some game consoles now use LCD screens to increase playing comfort and enrich the gaming experience.

Avago's APDS-90XX ambient light sensor optimizes both power consumption and comfort in viewing the console screen by automatically adjusting screen brightness and contrast to maximize eye comfort. The ambient light sensor also knows when environmental conditions are bright enough for the user to view the screen without backlighting.

Avago Technologie's APDS-90XX ambient light sensor provides portable game consoles with automatic screen brightness adjustment for increased playing comfort

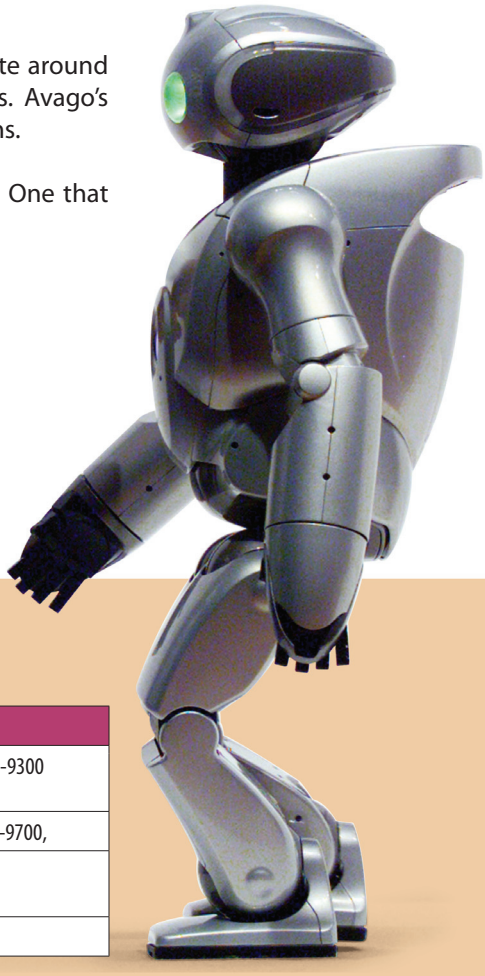
Robotics

Light/Object Detection

Humanoid and pet robots are growing in popularity. Sensors allow them to "get a feel" for the outside world. Sensors also allow for early detection, which is useful in games like robotic soccer, where a proximity sensor might detect an approaching ball or opposing team.

For example, Avago's ambient and proximity sensors allow the robot to navigate around the house without hitting any obstacles regardless of the lighting conditions. Avago's HSDL-9100 proximity sensor can even be used for collision avoidance applications.

Avago's HSDL-9100 and APDS-9700, proximity sensors provide a total solution. One that can detect objects that are more than 200mm away.



Other Consumer Electronics Applications

Appliances	Function	Product	Product Recommended
Television	Automatic screen brightness adjustment	Ambient Light Sensor	APDS-9005, APDS-9006 , APDS-9300
Headsets	Headphone user detection	Proximity Sensor	HSDL-9100, APDS-91XX, APDS-9700,
Game Console	Automatic screen brightness adjustment	Ambient Light Sensors	APDS-9008, APDS-9300
	Gesture control	Proximity Sensor	HSDL-9100, APDS-9700

Household Electrical Appliances

Time-to-market and reliability are key concerns for the white goods and home appliances market. Avago's design expertise and industry leadership combine to help customers improve the performance, reliability and cost of their designs. Some of the applications in this market segment that are best served by Avago's infrared and sensing products are:

- Irons
- Desktop Lamps
- Refrigerators
- Robot Vacuum Cleaners

Avago's HSDL-9100 proximity sensor adds an extra measure of safety to common household electrical appliances.

Iron

Safety On/Off Switch

Consumer mishaps, such as leaving a hot iron on a favorite shirt too long, occur often. New and emerging consumer electronics products must protect consumers from these accidental mishaps.

Placement of Avago's miniature proximity sensor on the iron's handle will ensure that the iron turns on only when it is being held by the user. The iron shuts down once the user's hand leaves the handle.

Avago Technologies' HSDL-9100 proximity sensor adds an extra measure of safety to common household electrical appliances

Avago's HSDL-9100 proximity sensor allows robots to navigate around the house by object detection

Desktop Lamp

Contactless Switch

Consumers manually turn desktop lamps on or off. Some consumers also use a dimmer switch to change the brightness of the lamp.

Mounting Avago's HSDL-9100 proximity sensor on the lamp base allows the user to simply wave their hand near the base of the lamp to turn it on. The brightness of the lamp can be changed by the various distances at which the hand is waved.

Refrigerator

Drink Dispensing Cup Detection

Drink dispenser machines use a mechanical latch to turn on the tap valve. This latch is not intuitive and very bulky.

With Avago's miniature proximity sensor, a smaller and neater dispenser unit can be designed that allows for easy walk-up user access. The proximity sensor senses the presence of a cup and begins dispensing the beverage. When the cup is removed the valve closes and the dispensing of the beverage ends.

Automatic drink dispensing, via Avago's HSDL-9100 proximity sensor, is now a viable application

Household Electrical Applications

Appliances	Application	Product	Product Recommended
Iron	Safety on\off switch	Proximity Sensor	HSDL-9100, APDS-9700
Robot Vacuum Cleaner	Object detection	Contactless Switch	HSDL-9100, APDS-9700
Lighting\Desk Lamp	Contactless switch	Proximity Sensor	HSDL-9100, APDS-9700
Refrigerator	Ambient light detection	Ambient Light Detection	APDS-9005, APDS-9300
	Cup detection in beverage dispensing	Proximity Sensor	HSDL-9100, APDS-9700

Office Equipment

Some of the applications in this market that are best served by Avago's sensing products are:

- Photocopiers
- Printers
- Paper Cutter Machines

Photocopier

Paper Level Detection

A mechanical latch is used to determine how much paper is left in the photocopy-making tray.

Avago's proximity sensor is an ideal solution for detecting the paper level in photocopiers. When combined with software measurements, this sensor determines specifically how much paper is left in the tray. More than one proximity sensor is required for this application.

Avagos' proximity sensor is ideal for paper level and paper edge detection

Printer

Paper Edge Detection

Many photo printers promote borderless photo printing – a feature that requires the printer to detect the paper edge.

Avago's proximity sensor moves the print head to the correct position. This allows the printer to sense when paper has been inserted and triggers a feeder mechanism that activates the printer to pull the paper through.

Household Electrical Applications

Appliances	Function	Product	Product Recommended
Multi-Function Peripherals\Copiers	Ambient light sensing	Ambient Light Sensors	APDS-9005, APDS-9008, APDS-9300
	Paper detection	Proximity Sensor	HSDL-9100, APDS-91XX Series, APDS-9700

More efficient printing solutions through paper level detection and paper edge detection

Industrial Systems & Automotive Applications

High performance and reliability are two driving factors in the Industrial Systems marketplace. Avago's industry leadership and years of experience makes it an ideal supplier for this competitive and ever expanding market. Some of the applications in this space that are best served by Avago's infrared and sensing products are:

- Handheld Medical Instruments for data collection
- E-meters
- Lighting Management
- Kiosks
- Automobiles
- Sanitary Automation

Automotive

Control Lighting

Most automotive manufacturers do not measure the vehicle's interior ambient light to enable automatic display lighting adjustment of display lighting. Instead, users must manually adjust the lighting to suit their environment.

With the APDS-9005, APDS-9300 (Digital ALS with I2C interface), dashboard lighting can self-adjust to the brightness to compensate for surrounding light conditions. This capability reduces eye strain and provides optimal viewing for drivers on roads in diverse daylight, dawn and night time conditions.

Gesture Control

Proximity sensors can be used for in-car entertainment systems for gesture control to replace the mechanical switches.

Industrial Systems Applications

Appliances	Function	Product	Product Recommended
Lighting Management	Ambient light sensing	Ambient Light Sensors	APDS-9005, APDS-9300
	Contactless switches	Proximity Sensors	HSDL-9100, APDS-9700
Handheld Medical Instruments	Ambient light sensing	Ambient Light Sensors	APDS-9008, APDS-9300
	Object detection	Proximity Sensor	HSDL-9100, APDS-9700
Energy Meters	Detection of the disc	Proximity Sensor	HSDL-9100, APDS-9700
Security Devices	Tamper proof switch	Proximity Sensor	HSDL-9100, APDS-9700
Automotive	Dashboard lightings control	Ambient Light Sensors	APDS-9005, APDS-9300
	Electronic rearview mirrors	Ambient Light Sensors	APDS-9005, APDS-9300
	Position of electronic rearview mirrors	Proximity Sensors	HSDL-9100, APDS-9700
	Replacement of mechanical switches	Proximity Sensors	HSDL-9100, APDS-9700
Vending Machines	Coin\notes detection	Proximity Sensors	HSDL-9100, APDS-9700
	Inventory control	Proximity Sensors	HSDL-9100, APDS-9700

About Avago Technologies

Avago Technologies is a leading supplier of analog interface components for communications, industrial and consumer applications. By leveraging its core competencies in III-V compound and silicon semiconductor design and processing, the company provides an extensive range of analog, mixed signal and optoelectronics components and subsystems to more than 40,000 customers. Backed by strong customer service support, the company's products serve four diverse end markets: industrial and automotive, wired infrastructure, wireless communications, and computer peripherals. Avago has a global employee presence and heritage of technical innovation dating back 40 years to its Hewlett-Packard roots. Information about Avago is available on the Web at www.avagotech.com

For product information and a complete list of distributors, please go to our web site:

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