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System Solution Guide - Preview

Augmented and Virtual Reality Headset

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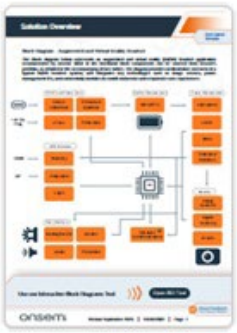
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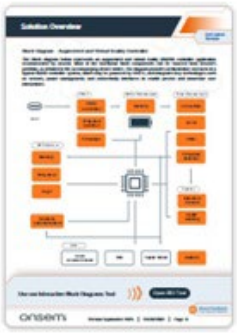
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Block Diagram

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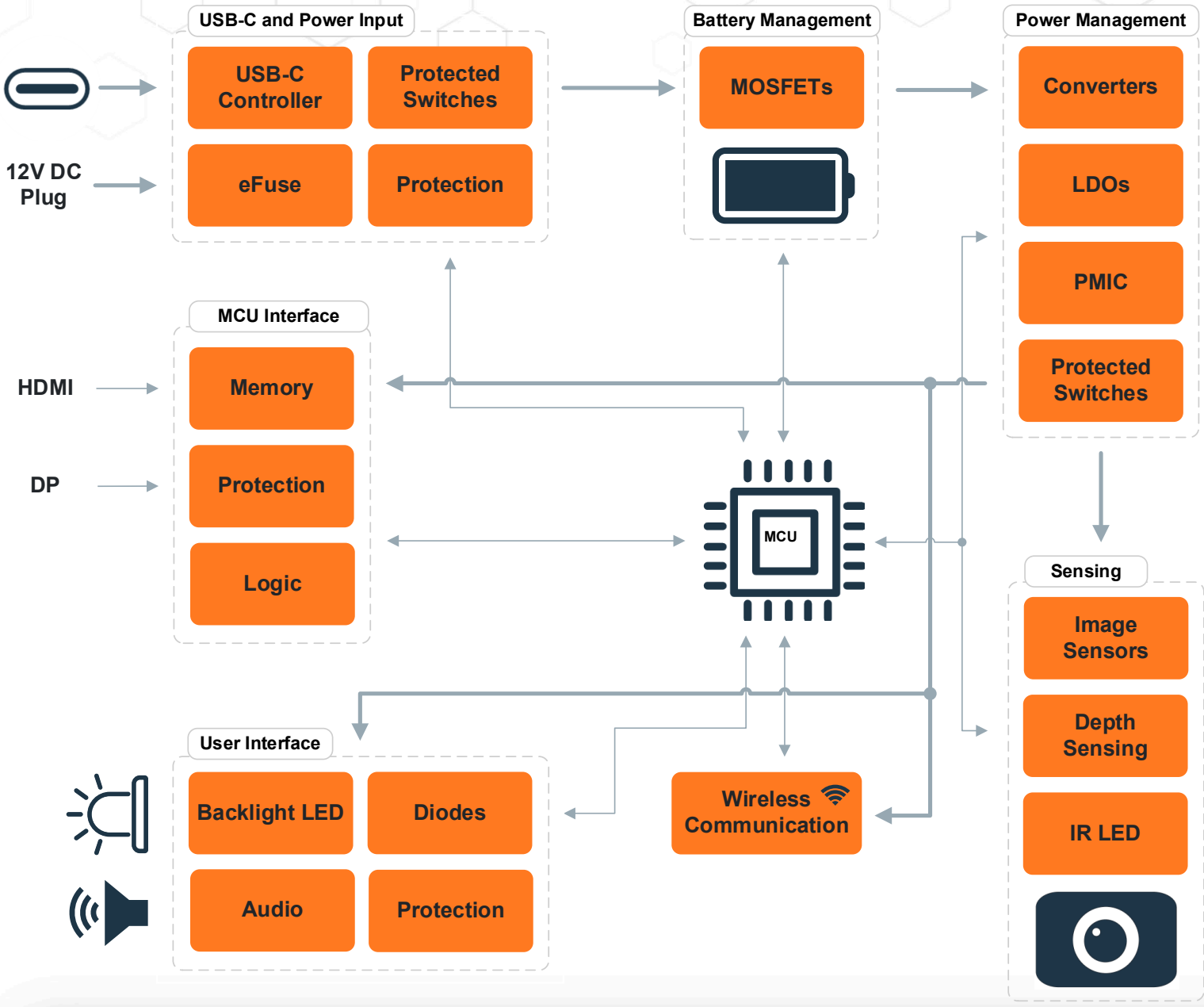
Block Diagram – Augmented and Virtual Reality Headset

The block diagram below represents an augmented and virtual reality (AR/VR) headset application recommended by onsemi. Most of the functional block components can be sourced from onsemi's portfolio, as detailed in the accompanying device tables. The diagram provides an illustrative overview of a typical AR/VR headset system, and integrates key technologies such as image sensors, power management ICs, and connectivity modules to enable immersive and responsive user experiences.



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Solution Overview

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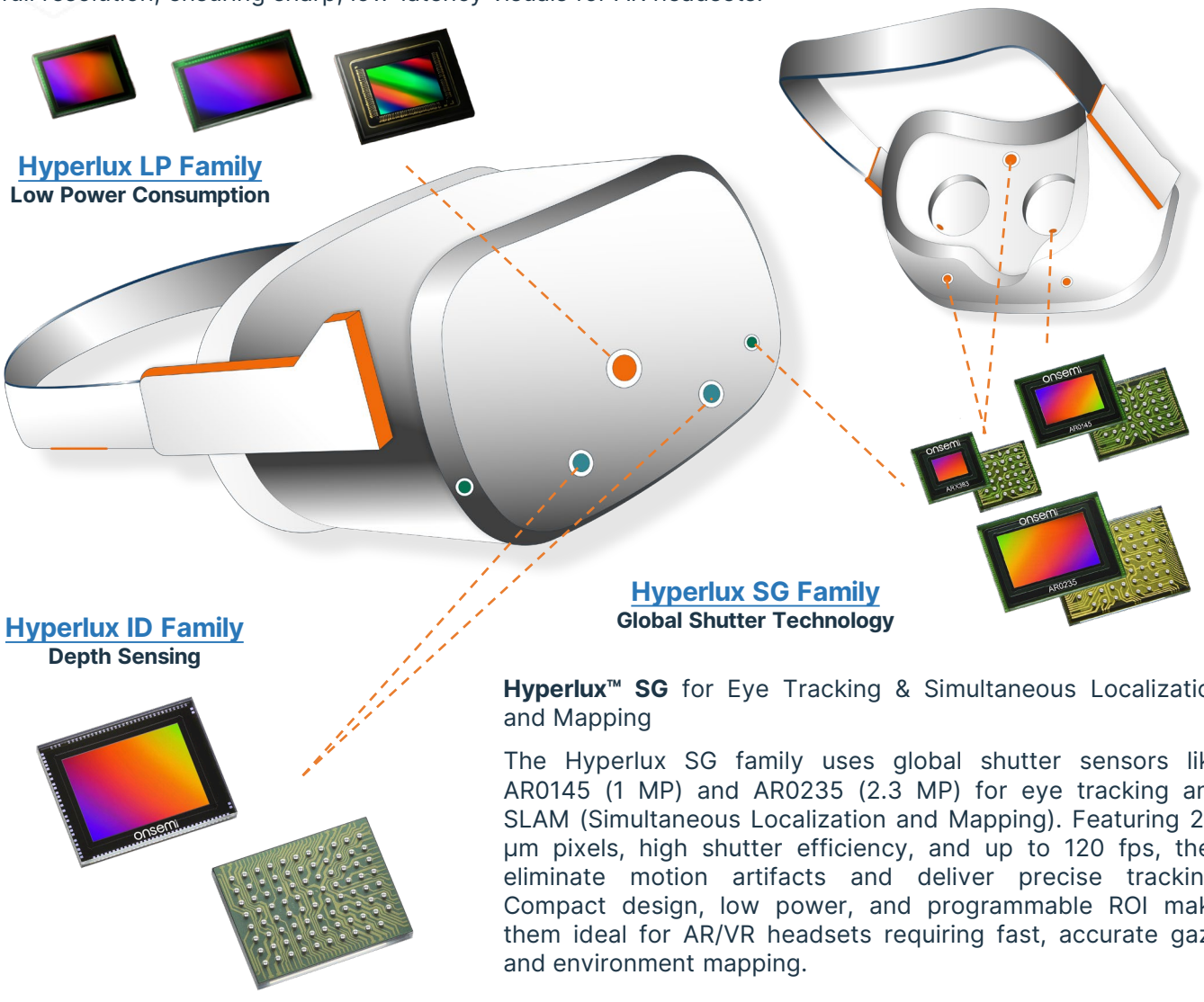
onsemi's Image Sensors in AR/VR Headsets

onsemi delivers cutting-edge image sensor technologies designed to enhance the performance and realism of AR/VR headsets. Our Hyperlux™ image sensor families provides exceptional image quality, low latency, and power efficiency enabling immersive, responsive, and visually stunning experiences. From high-resolution video see-through to precise depth sensing and eye-tracking, **onsemi's** solutions set the standard for next-generation AR/VR applications.

Hyperlux™ LP AR2020 for Video See-Through

The AR2020 is a 20 MP (5120 × 3840) BSI stacked CMOS sensor optimized for Video See-Through (VST) in AR/VR. It offers a 1/1.8-inch format, 1.4 µm pixels, and LI-HDR for high dynamic range. With enhanced NIR sensitivity (850/940 nm), SmartROI, and Wake-on-Motion, it supports MIPI CSI-2 and streams 60 fps at full resolution, ensuring sharp, low-latency visuals for AR headsets.



Hyperlux™ SG for Eye Tracking & Simultaneous Localization and Mapping

The Hyperlux SG family uses global shutter sensors like AR0145 (1 MP) and AR0235 (2.3 MP) for eye tracking and SLAM (Simultaneous Localization and Mapping). Featuring 2.8 µm pixels, high shutter efficiency, and up to 120 fps, they eliminate motion artifacts and deliver precise tracking. Compact design, low power, and programmable ROI make them ideal for AR/VR headsets requiring fast, accurate gaze and environment mapping.

Hyperlux™ ID Depth Sensors (AF0130/AF0131)

The AF0130 and AF0131 are 1.2 MP iToF depth sensors for AR/VR navigation. They feature 3.5 µm global shutter pixels, 200 MHz modulation, and >40% QE at 940 nm, enabling accurate depth up to 30 m. AF0130 includes on-chip depth processing at 60 fps, while AF0131 supports external compute. Both offer dual laser control and eye-safety, ideal for SLAM, gesture control, and collision avoidance.

Solution Overview

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Hyperlux LP - Image Sensor Family

Recently, **onsemi** launched the Hyperlux™ LP series of image sensors. This series incorporates cutting-edge electronic rolling shutter technology and consists of three product variants: the AR0544 with a resolution of 5MP, the AR0830 with 8.3MP, and the AR2020 with 20MP. All sensors within the Hyperlux™ LP family feature identical pixel sizes and optical performance. The product lines provide a variety of options, including mono, RGB, and RGBIR variants, available in both packaged and die forms. This extensive selection allows vision system designers to optimize development efforts, reduce expenses, and accelerate time-to-market (TTM) by leveraging diverse solutions.

Tab. 1: Hyperlux image sensors specifications

	AR0544	AR0830	AR2020
Resolution	5MP, 2592 x 1944	8 MP, 3840 x 2160	20 MP, 5120 x 3840
Pixel, Color Filter	1.4 µm BSI, RGB/Mono/RGB-IR	1.4 µm BSI, RGB/Mono/ RGB-IR	1.4 µm BSI, RGB/Mono
Optical Format	1/4.2-inch (4:3)	1/2.9-inch (16:9)	1/1.8-inch (4:3)
SNR - Max	39.9 dB		
Dynamic Range	73 dB (eDR 1-exp)		
Subsampling Modes	Binning/Skipping/Summing		

Power Consumption

In the pre-detect state, Hyperlux™ LP image sensors consume less than 1/100th of the power consumed in the native mode. This results in substantial power savings and extends the operational cycle of vision systems that are sensitive to power consumption.

Tab. 2: Image sensor power consumption comparison in full resolution mode

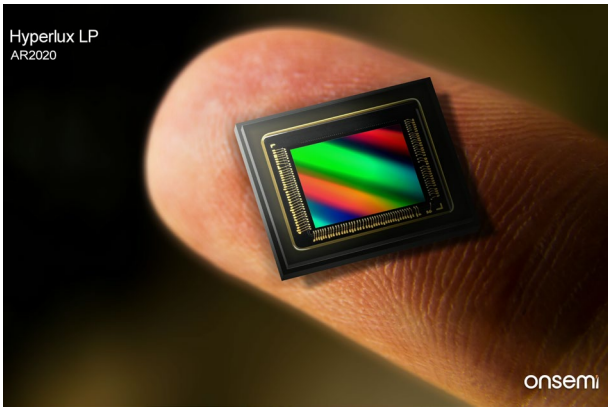
	AR0544	AR0830	AR2020
Power Consumption (Full Resolution, Typical 25C)	< 170 mW @ 60 fps	190 mW @ 60 fps	~400 mW @ 60 fps

Hyperlux LP AR2020

onsemi's Hyperlux AR2020 image sensor stands out as a top-tier choice, offering a suite of advanced features that cater specifically to the demanding needs of modern security systems. This advanced sensor is capable of capturing images in either linear or enhanced Dynamic Range (eDR) modes, with a rolling-shutter readout. Additionally, it features a built-in **Wake on Motion (WoM)** function and supports **Smart Region of Interest (ROI)**, allowing for optimized image capture and processing efficiency.

Features and Specifications:

- 20 MP CMOS Sensor with 1/1.8-inch Back-Side Illuminated (BSI) stacked CMOS sensor and 1.4 µm pixel technology
- Enhanced NIR Response at 850 nm and 940 nm Wavelength
- LI−HDR: Supports Line Interleaved T1/T2 Readout to Enable HDR Processing in ISP Chip (eDR)
- Bit−depth Compression Available for MIPI Interface
- Various Trigger Modes for Multi−sensor Synchronization
- Electronic Rolling Shutter (ERS) and Global Reset Release (GRR) Modes Supported



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Hyperlux ID - Smart iToF Global Shutter Depth Sensors AF0130 & AF0131

Indirect Time-of-Flight (iToF) technology measures the phase shift of modulated light pulses to accurately calculate distances. This method allows for precise 3D imaging and depth perception, making it ideal for various industrial applications. These sensors can be used stand-alone or complementarily with other depth sensing techniques to increase the data accuracy. In robotics systems they can be used for calculation of the depth required for a robotic arm to grab and manipulate objects. Other possible application is environmental map creation which is used for floor navigation.

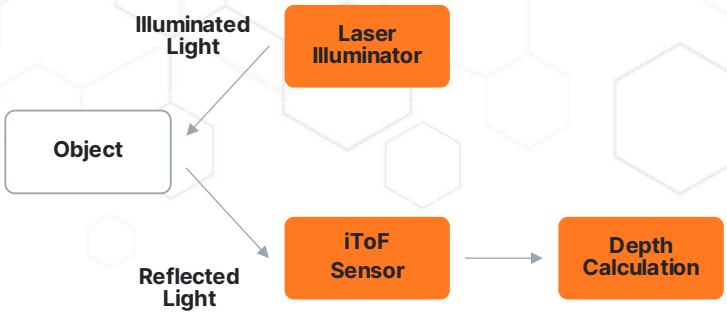


Fig. 2: Indirect time of flight principle

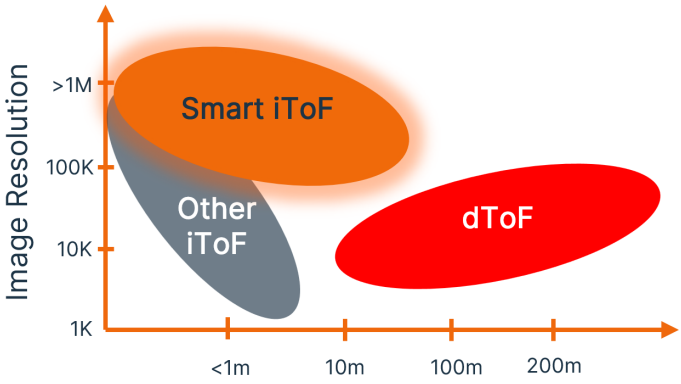
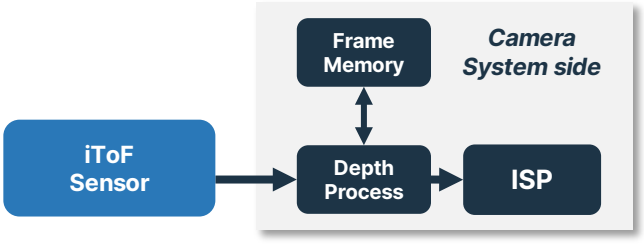


Fig. 3: Smart iToF extends sensing distance owing to unique intermitted laser modulation

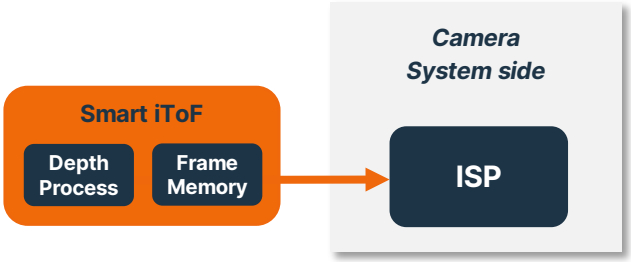
They offer several advantages. They provide high depth accuracy, which is crucial for tasks that require precise 3D mapping and object detection. Their ability to operate at high frame rates ensures reliable performance in dynamic environments, capturing fast-moving objects with ease. Additionally, these sensors are optimized for low power consumption, making them suitable for battery-powered and multi-sensor systems.

The robust performance of Hyperlux ID depth iToF sensors in challenging conditions, such as low-light and high dynamic range environments, ensures reliable operation across diverse application settings.

Existing iToF solution



onsemi Smart iToF solution



Required resources for depth calculation:

- FPGA or MCU
- Frame memory
- High speed interface (for > 1 MP)

Output depth map directly from sensor:

- Less external devices
- Lower computation and power
- Relaxed interface speed

Augmented and Virtual Reality Headset

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