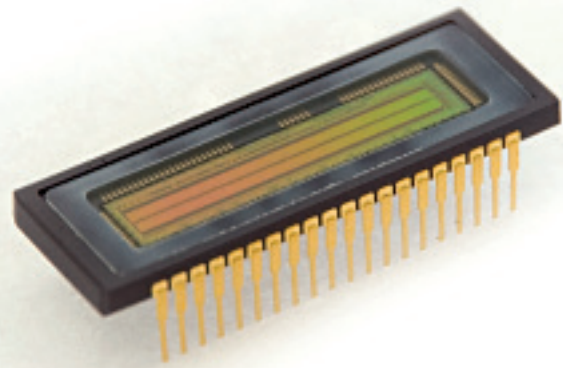




**AnaFOCUS**

LEADING ON-CHIP VISION SOLUTIONS



# 4k pixel 18,180lps line-scan CMOS image sensor

## Overview

The LS4k is a high-speed CMOS system-on-chip (SoC) line-scan image sensor optimized for applications requiring short exposure times and high accuracy line rates.

It incorporates on-chip two pixel arrays consisting of 4 rows with 4,096 7 $\mu$ m-pitch pixels and 4 rows with 2,048 14 $\mu$ m-pitch pixels respectively, a high-accuracy (12-bit) high-speed (84MHz) analogue-to-digital (A/D) conversion, and sophisticated on-chip optical calibration for PRNU, DSNU, and lens shading correction.

The CMOS line sensor array utilizes active CMOS pixels with pinned photodiodes to deliver high image quality whilst maintaining the size, cost, and integration advantages of the CMOS.

The readout path permits CMOS pixel binning (1xN with

N up to 4) increasing response and line-rate. Windowing or sub-sampling allows achieving a maximum line rate of 82,400 lines-per-second (lps) for 500-pixel window.

The line-rate, image sub-sampling, windowing, binning, exposure time, gain, and other image processing features are controlled via the sensor configuration registers.

The LS4k incorporates an SPI port to communicate with an external host device and three high-speed LVDS ports for data output.

The reference voltages are generated on-chip from an internal band-gap reference. No external components are required. A power-down mode is available for low current consumption when the device is inactive.

# Key features<sup>(1)</sup>

- 84MHz throughput
- Dual pixel-array with pinned photodiode,
  - 7µm active-pixel, resolution 4 x 4,096 pixels
  - 14µm active-pixel, resolution 4 x 2,048 pixels
- Global-shutter with programmable exposition time
- Maximum line-rate
  - 18,180lps at 4k-resolution,
  - 32,870lps at 2k-resolution,
  - 54,850lps at 1k-resolution, and
  - 82,400lps at 0.5k-resolution
- 65dB dynamic range (DR) (7µm and 14 µm pixels)
- SNR<sub>MAX</sub>
  - 45dB (7 µm pixel)
  - 48 db (14µm pixel)
  - 53,5dB (14µm pixel, 4 rows binning)
- 26nj/cm<sup>2</sup> saturation exposure
- 15pj/cm<sup>2</sup> noise-equivalent energy (NEE)
- Peak Response
  - 157DN/(nj/cm<sup>2</sup>) (7µm pixel)
  - 197DN/(nj/cm<sup>2</sup>) (14µm pixel)
- < 1% full-scale maximum Image lag
- 0.65% full-scale maximum uncorrected PRNU
- 0.03% full-scale maximum uncorrected DSNU

(1) Typical values measured with 7µm pixels (except when otherwise indicated) at maximum line-rate, 0dB gain, 25°C ambient temperature, and using a Tungsten halogen light source with 3200K bulb temperature and 750nm cut-off filter.

# Programmability

- 0dB to 30dB programmable gain in 1dB steps
- Pixel binning for increased SNR
- Line windowing and sub-sampling with faster line-rate
- On-chip PRNU, DSNU and lens shading correction
- Sensor programming via 40Mhz SPI port

# Miscellaneous

- 40-lead ceramic package
- Dual 3.3V/1.8V power-supply
- 700mW maximum power consumption
- 12MHz external clock (XTAL) frequency
- -30°C to +70°C operating temperature

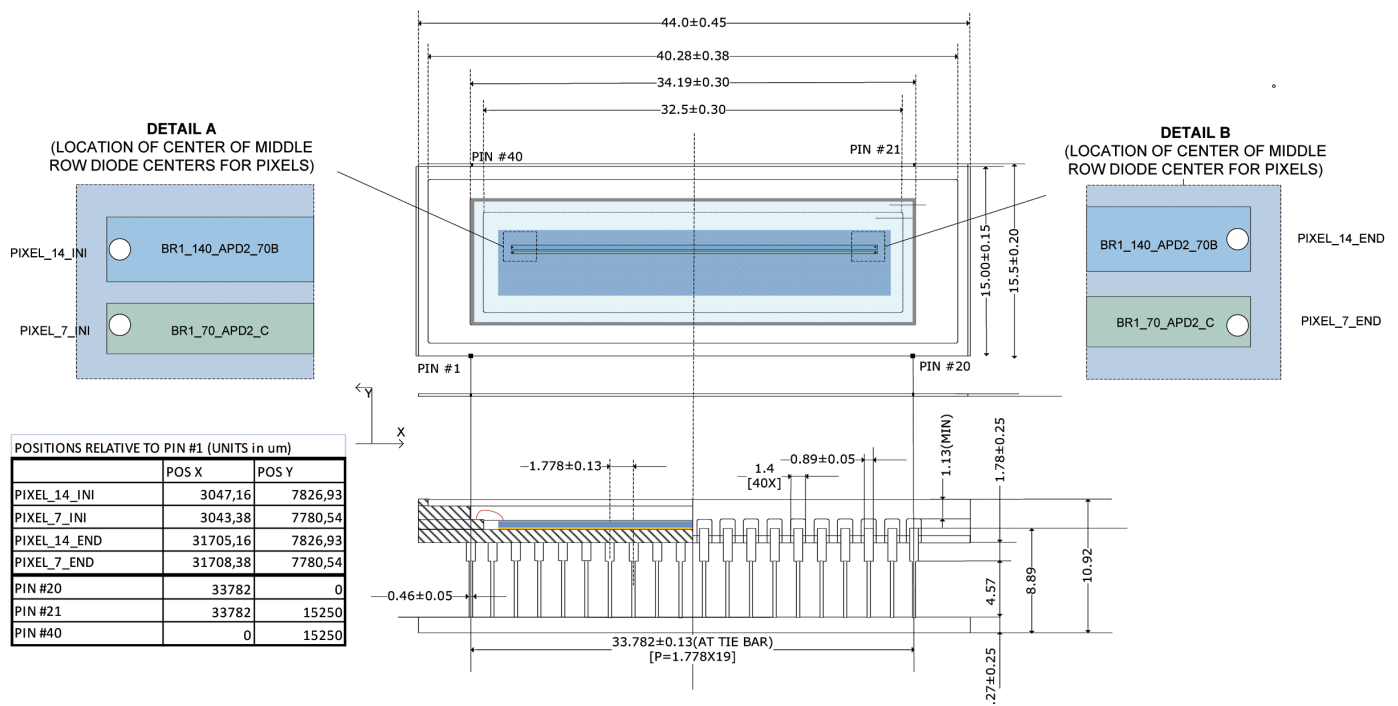
# Applications

- Printed-circuit board inspection
- High-performance document scanning
- Flat-panel display inspection
- General machine-vision

The complete camera reference-design, including fully-documented PCB schematics, PCB layout, FPGA firmware and communication and control software is available for customers willing to develop new line-scan camera using the LS4k CMOS Image Sensor.

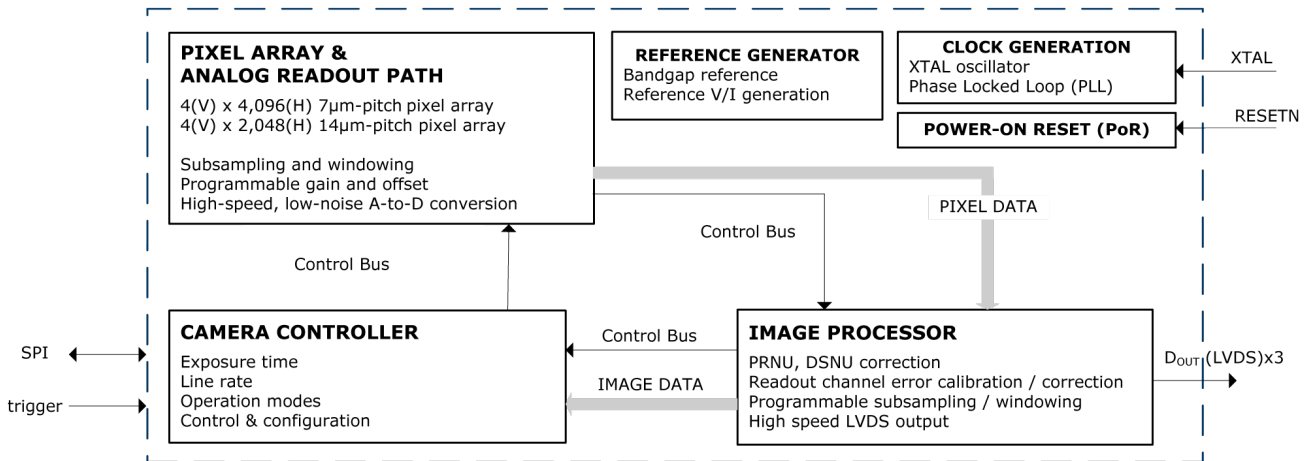
# Package drawings

Figure 1 – Mechanical drawing of the LS4K line-sensor package



# Image sensor block diagram

Figure 2 – Functional diagram of the LS4k line-sensor



# Quantum Efficiency

Figure 3 – Quantum efficiency for 7µm pixel

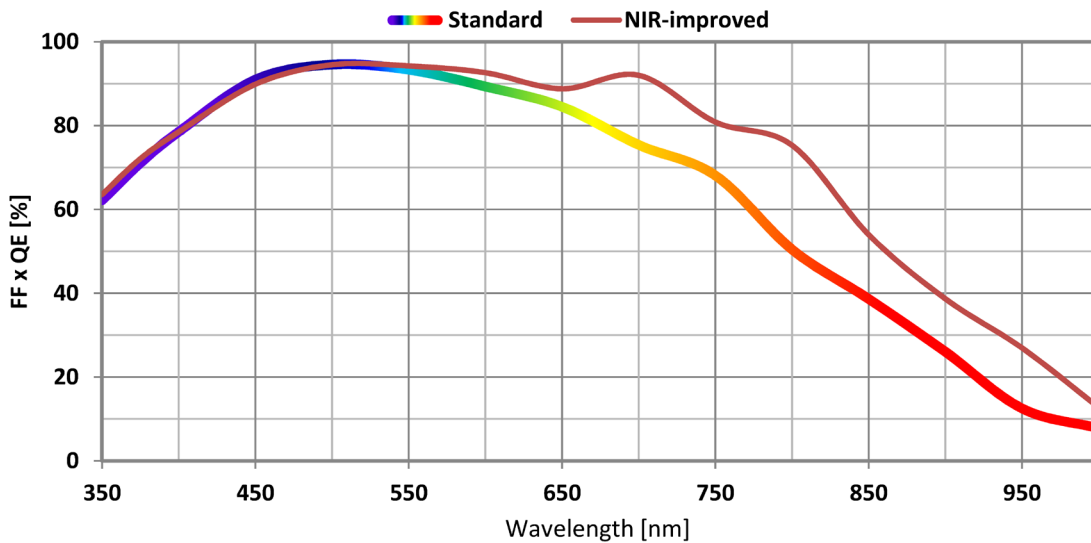
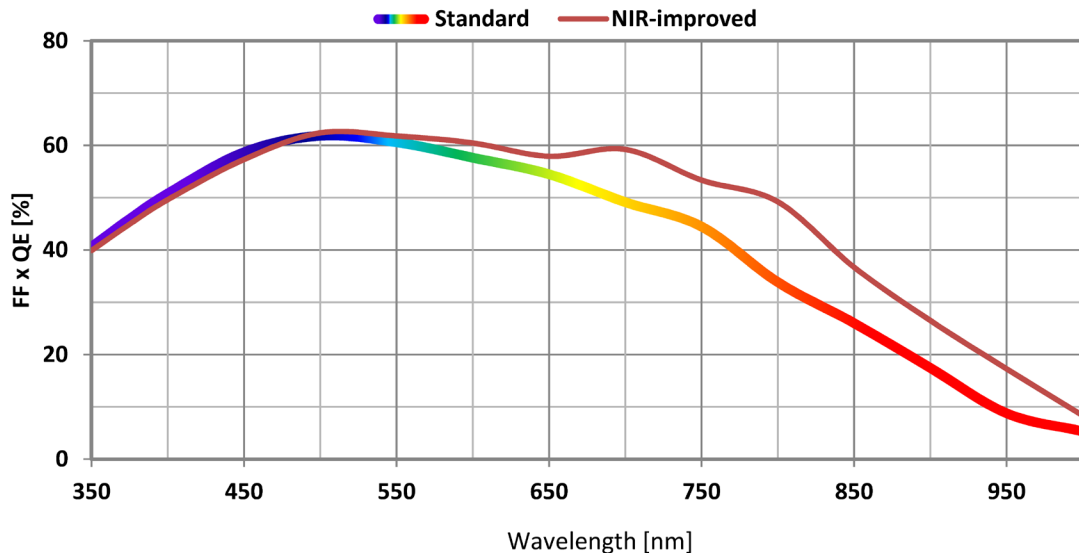


Figure 4 – Quantum efficiency for 14µm pixel





## About AnaFocus

ANAFOCUS is a privately owned, pure-play supplier of standard off-the-shelf and customised high-performance, high-quality CMOS image-sensors and vision-sensors for the industrial, professional, scientific, medical and high-end surveillance markets.

ANAFOCUS started its operation in 2004. It is headquartered in the Scientific and Technological Park CARTUJA in Seville (SPAIN) where employs 50 engineers and technicians and occupies a total surface of 1,000m<sup>2</sup>, one fourth dedicated to technical installations including optical test labs, qualification labs, and clean-room facilities for image-sensor wafer-sort and packaged-sample test.

ANAFOCUS provides commercial and technical support by own employees in Tokyo (Japan) since 2006. ANAFOCUS works for top-tier camera makers worldwide developing innovative image and vision-sensor solutions for various application sectors.

Carefully understanding customer needs and providing timely and fully satisfactory solutions is ANAFOCUS top priority and a great success thus far; all customers for custom image-sensor solutions in Japan and worldwide have repeated business in two or more occasions.

ANAFOCUS key competence is the ability to develop on-chip-solutions combining:

- High-sensitivity, low-noise pixels based on pinned photodiode technology; global and rolling shutter with linear and HDR sensing
- Advanced analog front-end circuits for reading & digitizing the pixels at high-speed and with very low noise.
- Area and power efficient digital processors performing optical corrections (FPN correction, shading correction, defective-pixel correction, colour-processing...) on the images, in real-time, before being outputted through high-speed LVDS ports or conventional CMOS ports.
- Sophisticated control logic, such as on-chip microcontrollers that simplify the communication with the sensor chip and provide great flexibility.

Besides its CMOS image sensor design and production capabilities, ANAFOCUS employs an experienced engineering team with over 15 members expert in the development of camera complex hardware, FPGA firmware and software and real-time image processing algorithms. This team, together with a dedicated project management and specialized product engineering team, closely work with customers engineering team in the whole camera development cycle: from concept to commercialization.

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