Precision Timing Solutions

Industrial Cameras

Precision Timing in Industrial Cameras

Industrial cameras are a key element of machine vision systems. Typical applications include automatic imaging-based inspection, process control, robot guidance, surveillance, microscopy, motion analysis, mapping, document digitizing, as well as medical imaging. Data collected by cameras are usually processed by a computer, with or without artificial intelligence.

Key Considerations

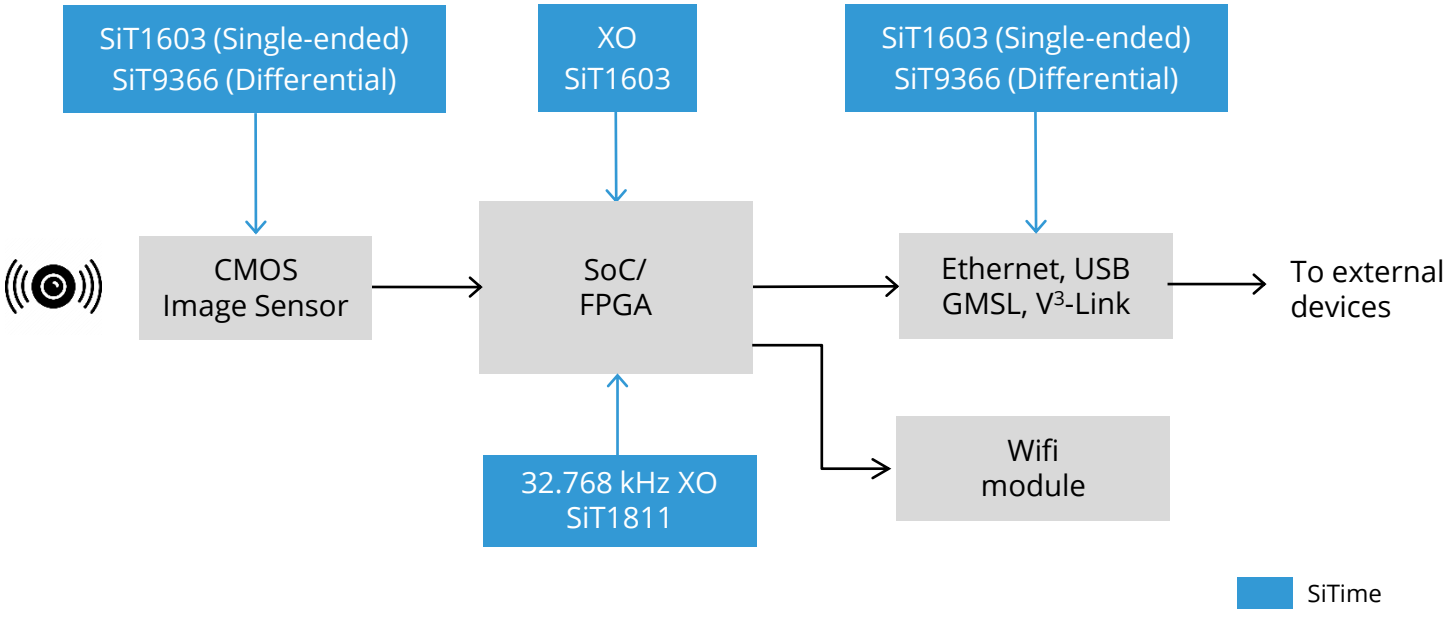
- Jitter performance
- Small footprint
- EMI reduction
- Low power

Camera systems are based on a CMOS imager, a processing SoC or FPGA, and interfaces to transfer images to the "outside world." Depending on the application, imagers of different resolutions and frame rates are chosen. CMOS image sensors exist in different sizes. In general, the larger the sensor size, the better the dynamic range and signal-to-noise (SNR) ratio.

An SoC or FPGA processes the data collected by the image sensor. Typical processing includes creating usable still images or a video stream from the raw sensor data and compressing them for transmission. More advanced processing such as pattern recognition can be performed either in-camera, or in a central computer.

Various interfaces to connect cameras to other elements of a machine vision system exist. The most common are Ethernet, USB, GMSL (Analog Devices), V^3-Link and FPD-Link (Texas Instruments). Wifi or proprietary wireless interfaces can also be used.

Block Diagram



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Typical CMOS imagers require a fixed frequency clock between 6 MHz and 72 MHz. As a general rule, the higher the sensor data rate, the higher the clock frequency. The data rate mainly depends on three characteristics:

- resolution, related to sensor size (ranging from 5 x 4 mm to 54 x 40 mm) and pixel pitch
- frames per second
- bits per pixel

As digital devices, SoCs and FPGAs can be easily clocked with a single-ended oscillator in the 10 to 40 MHz range such as the SiT1603. An optional 32.768 kHz oscillator can be added if real-time-clock timekeeping is needed. A low-power oscillator such as the SiT1811, consuming only 6 µA, enables accurate time keeping in standby mode.

Interface clocking depends on the chipset; in general:

- Ethernet with a single-ended 25 MHz
- USB with a single-ended 48 MHz or a differential 100 MHz
- GMSL with a single-ended clock with frequency such as 25 MHz
- V3-Link and FPD-Link with a single-ended frequency in the range of 25 MHz to 100 MHz

SiTime advantages

- Up to 2x better stability, 10x lower jitter than crystal-based oscillators
- Up to 50x better immunity to EMI than crystal-based oscillators
- EMI reduction features
- 30x better shock and vibration resistance
- Factory programmable to any frequency
- Wide operating temp (-40°C to 105°C)
- Industry-leading small package sizes down to 1.5 x 0.8 mm CSP

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Featured products – please refer to SiTime.com or contact us for more options.

Type	Product	Frequency	Key Features	Key Values
MHz oscillator	SiT8008	1 to 110 MHz	• -40°C to +85°C • ±20 ppm stability • 5 std package sizes	• High reliability • Flexible frequency options • Excellent stability over temperature
	SiT1602	52 std freqs from 3.57 to 77.76 MHz		
	SiT8021	1 to 26 MHz	• -40°C to +85°C • ±50 ppm stability • 1.5 x 0.8 CSP package	• High reliability • Extended temperature range • Small footprint • Wide programmable freq range
	SiT1603[1]	8 to 76.8 MHz (various specific frequencies)	• -40°C to +85°C • ±25 ppm stability • 2 mA current consumption • 0.75 fs rms phase jitter	• High reliability • Low power • Various standard package options
Differential oscillator	SiT9366	1 to 220 MHz	• Low jitter 0.23 ps RMS[1] • LVPECL, LVDS, HCSL • 2.5 to 3.3 V • -40°C to 105°C • 3.2 x 2.5 mm package	• Meets demanding jitter requirements • Small PCB footprint, easier layout • Easy design due to flexibility • MEMS reliability
32.768 kHz oscillator	SiT1811[1]	32.768 kHz	• ±20, ±50 ppm stability • 1.14 to 3.3 V supply • typ. 490 nA current consumption (no load) • Up to -40°C to +105°C • 1.2 x 1.1 mm QFN	• Low power • Small footprint • Excellent stability enables better time keeping over longer periods of standby time, thus saving even more power
32.768 kHz TCXO	SiT1552	32.768 kHz	• ±5, ±10, ±20 ppm stability • 1 µA current consumption • Up to -40°C to +85°C • 1.5 x 0.8 CSP package	

[1] Please contact SiTime for availability.

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