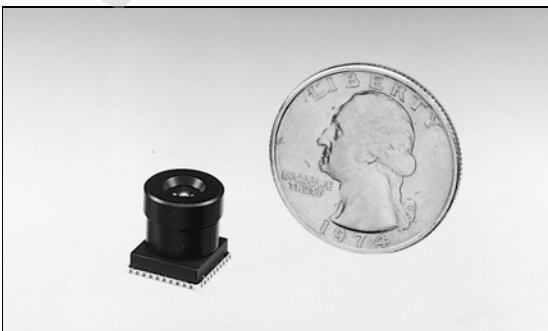# Compact, Low-Power VGA 1/4-Inch CMOS Color Image Sensor: MB86S01

*Featuring high-sensitivity, this 350,000-pixel (VGA) digital CMOS color image sensor has low-noise photodetector construction in the photosensor array unit. Combined with the MB86571 color processor, it can be configured for compact, low-power camera systems.*

## Features

- **Industry-leading, low-height 10-mm profile**

- **Low power consumption**

- **Variable frame rate**

- **Built-in timing generator**

**Photo 1. MB86S01 External View**



## Product Overview

FUJITSU has developed the MB86S01 1/4-inch CMOS color image sensor with 350,000 pixels for digital cameras and cameras in portable terminal devices. Current uses of CMOS sensors include compact digital cameras and notebook PC cameras. With rapid market growth expected, the advantages offered by the CMOS sensor, in terms of low power consumption and compact size, are expected to be in strong demand.

The MB86S01 uses optimized analog circuit and A/D converter design to provide the lowest level of power consumption for any VGA CMOS sensor in the industry. In addition, the power-saving mode and low-power functions can be used for even lower power consumption levels.

> **". . . the lowest level of power consumption for any VGA CMOS sensor in the industry."**

FUJITSU has developed the MB86571 color processor together with the MB86S01 low-power CMOS image sensor to provide color signal processing. For more information about the MB86571, see p. 18 in this issue of *FIND*.

FUJITSU process engineering with our own proprietary improvements to CMOS technology is used to produce a compact photodetector array (1/4-inch optical system) with high image quality. An optical simulator optimizes the on-chip micro lens for improved sensitivity.

Along with the development of the image sensor, we have developed a new package in one unit with a compact lens. The package consists of two high-resolution compact plastic lenses in the world's smallest package, with a built-in VGA sensor (10 mm x 10 mm x 10mm), enabling customers to further reduce overall product size.

The MB86S01 is also available in a 40-pin LCC package (without lens: 12 mm x 12 mm x 1.5 mm), which is ideal for general applications.

Despite its compact 1/4-inch size, the MB86S01 provides the low power consumption and high image quality essential in small digital cameras and portable data terminals. It is suitable for a wide range of applications in 21st century image input devices.

**Photo 2.    MB86S01 Sample Photograph**



# Product Features

## *Industry-Leading, Low-Height 10-mm Profile*

The combination of a thin, high-performance lens and a newly designed package provides the smallest VGA sensor package in the industry. The trim, 10-mm profile will contribute to slimmer application designs.

## *Low Power Consumption*

By optimizing the analog circuit and A/D converter, the MB86S01 achieves the industry's lowest power consumption level for a VGA CMOS sensor.

## *Variable Frame Rate (intermittent output mode)*

Intermittent image output is used in power-saving mode. This feature can be used to greatly reduce power consumption in the camera module when real-time images are not required.

Figure 1 (see p. 15) shows the relation between power consumption and output interval.

## *Built-In Timing Generator*

The MB86S01 has built-in circuits for generating internal signals and synchronization signals. Timing is generated using only a clock signal input, eliminating the need for other external timing generator circuits.

# Principal Specifications

Table 1 (see p. 15) lists the principal specifications, and Table 2 (see p. 16) lists the package specifications.

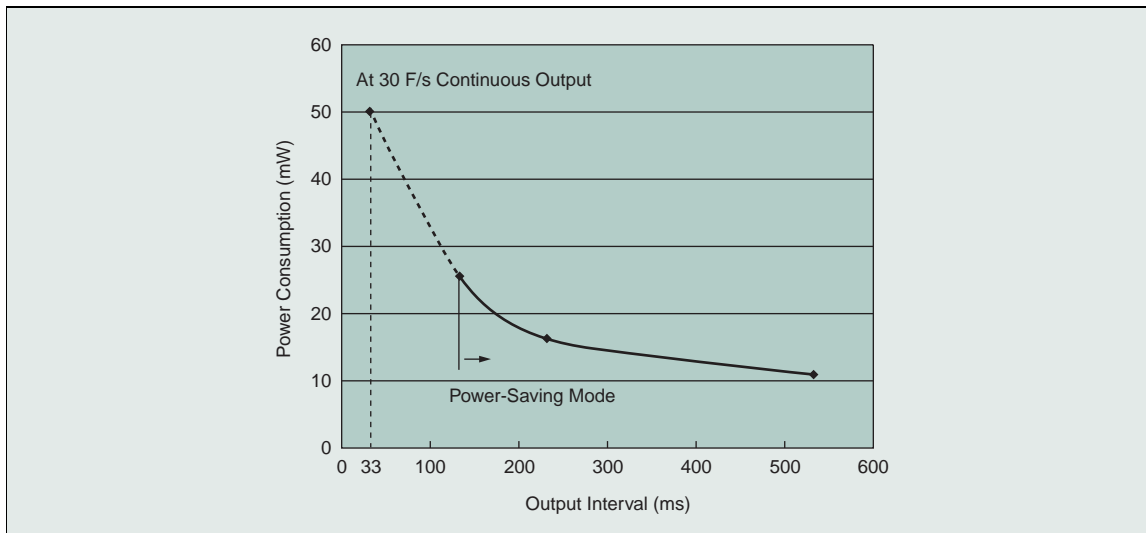*Figure 1.    Power Consumption in Power-Saving Mode*



*Table 1.    MB86S01 Principal Specifications*

| Item | Specification |
|---|---|
| Optical Size | 1/4 Inch |
| Total Pixel Number | 693 (H) x 513 (V) |
| Effective Pixel Number | 645 (H) x 485 (V) |
| Pixel Size | 5.5 µm Square (square element) |
| Color Filter | RGB Mosaic Filter |
| Internal Circuits | FPN Reduction Circuit, PGA, Black Clamp Circuit, 8-Bit A/D Converter, Timing Generator Circuit |
| Power Supply Voltage | 2.7V to 3.3V |
| Power Consumption | 50 mW |
| Master Clock | 27 MHz |
| Digital Input/Output | CMOS Level |
| Register Control | 3-Line Serial Interface |
| Addtional Functions | Scan Direction Variation Function (mirror reflection, top/bottom inversion function) |

# Circuit Configuration

Figure 2 (see p. 17) shows the pin assignments, and Figure 3 (see p. 17) shows the block diagram.

The MB86S01 is configured from the following functional blocks.

## Focal Plane Array

The MB85S01 provides a high-sensitivity, high-image-quality pixel array using improved, proprietary FUJITSU focal plane array (FPA) technology.

## Fixed Pattern Noise Reduction Circuit

The Fixed Pattern Noise (FPN) reduction circuit suppresses fixed pattern noise, visible on the screen, by sampling pixels twice to remove noise variability from each pixel.

## Programmable Gain Amplifier

The MB86S01 has a programmable gain amplifier (PGA) that is capable of varying gain between 0 dB and 24 dB in nine steps of 3 dB each. This allows the element to respond to slight variations in brightness.

## Black Clamp Circuit

The black clamp circuit maintains a constant black level with respect to IC temperature changes. The black level can be output externally through the D/A converter.

## 8-Bit A/D Converter

The MB86S01 has a built-in, A/D converter (pixel rate 13.5 MHz), which uses circuit optimization to provide A/D conversion with low power consumption. The MB86S01 also includes a built-in reference voltage generator circuit.

## Timing Generator

The timing generator can be adjusted by register setting to provide various timing levels for synchronization signals.

# Future Development

This article introduced a 350,000-pixel CMOS sensor. In the future, FUJITSU plans to continue to develop and supply products with low power consumption, compact size, and high image quality to meet the demands of our customers. ◆

**Table 2.   MB86S01 Package Specifications**

| Item | 40-Pin LCC Package with Lens | 40-Pin LCC Package |
|---|---|---|
| IR Cut Filter | Glass lid built in | None (glass lid only) |
| Lens | F2.8 (2 plastic lenses) | None |
| External Dimensions | 10 mm x 10 mm x 10 mm | 12 mm x 12 mm x 1.5 mm |

*Figure 2.   MB86S01 Pin Assignments*



*Figure 3.   MB86S01 Block Diagram*