New Fast and Compact Color Sensors from ZMD

- **Color Filter On-chip, Micro-structured**
- **High Transmission**
- **High Slope of the Filter Edge**
- **Hard Surface**
- **Extremely Temperature-Stabilized (No Aging or Degradation)**

Rapid Color recognition with 3 - element color sensor

For industrial color applications with high dynamics, these new compact color sensors are a preferred choice. Three areas, each of different color, are responsible for the recognition - similar to the human eye.
Color sensors based on Si-PIN-diodes and dielectric filters on-chip feature a small design, high-quality filters and the synchronous recording of all three-color ranges. Furthermore, the circular alignment of the diodes allows simple coupling of the measurement signal using an optical fibre. The sensors are offered in the TO5 package with translucent plastic or cover glass and/or in the SOP8 with translucent plastic.
The color sensors are made of 3 Si-PIN photo diodes integrated on chip.

Each of these photodiodes is sensitized with a dielectric spectral filter for its color range, preferably for the primary colors red, green and blue. By direct mounting of the spectral filters onto the photodiodes, the sensor is a highly compact component. As a result, measuring systems based on this sensor can be sized considerably smaller than traditional color measuring instruments.

The 3-element color sensors require only 3 measured values. These are detected simultaneously for determining the color. As a result, the three field sensors allow for low-cost and fast signal processing. The Si-PIN photo diode design allows signal frequencies up to the MHz-range.

Technical overview

- ***3 Si-PIN photo diodes as segments of a ring integrated on chip***
- ***Diode diameter 2.0 mm***
- **High-quality dielectric color filter**
- **Wavelength region: 450 nm up to 750 nm**
- **Dark current (per Sector): 50 pA at 5V reverse voltage**
- **NEP (per Sector): Typ. 10^{-13} W Hz $^{-1/2}$**
- **Capacity (per Sector): Typ. 50 pF at 5V reverse voltage**
- **Reverse voltage max. 30V**
- **Rise time < 1 ns**

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1	V1.3	2000/03/16

DATA-SHEET

MCS3

3-Element Color Censor

Function

The color sensors are made of 3 Si-PIN photo diodes integrated on chip. They are carried out as segments of a ring with the diameter of 2.0 mm. The design as Si-PIN photo diodes allows signal frequencies up to MHz-range. In order to achieve a small cross talk between the photodiodes the individual sectors were separated from each other by additional structures. Each of these photodiodes is sensitised with dielectric spectral filter for its color range, preferably for the primary colors red, green and blue.

Application

- Quality control
- Monitoring the production
- Control of manufacturing
- Detection of color marks

Features

Dielectric filters guarantees the good optical properties of the color sensors, such as:

- high transmission
- slight aging of the filter
- high temperature stability
- high signal frequency
- reduced cross talk
- small size (diameter of the optical sensitive surface ca. 2.00 mm)

Construction

- 3 on chip integrated PIN photo diodes
- different package versions
- dielectric filters for the three color ranges: red, green and blue
- (SO8, TO5, with optics, IR-blocked, etc.)
- Electrical connections
  - three anodes
  - one common cathode

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MAXIMUM RATINGS / CHARACTERISTICS

(T_A = 25°C; per single diode)

Description	Symbol	Condition	typ. Value	Unit
Diameter of the light sensitivity area	D		2.0	mm
Light sensitivity area per element	A		0.85	mm²
Maximal photo sensitivity of the color ranges	S_{max}	$ë_B$ = 470 nm $ë_G$ = 570 nm $ë_R$ = 650 nm	0.26 0.33 0.41 (0.25)	A/W
Field of the spectral sensitivity	$ë_B$ $ë_G$ $ë_R$		400 - 510 490 - 610 590 - 750	nm
Reverse Voltage	V_R	0...9 V	5	V
Dark current	I_R	V_R = 5V	<100	pA
Terminal Capacitance	C	V_R = 5V	50	pF
Rise and fall time of the photocurrent	t_r, t_f		<1	µs
Noise equivalent power	NEP		$<10^{-13}$	W/Hz
Crosstalk			0.5	%
Operating temperature range	T_{op}		0 ... +70	°C
Storage temperature range	T_{st}		-20 ... +80	°C

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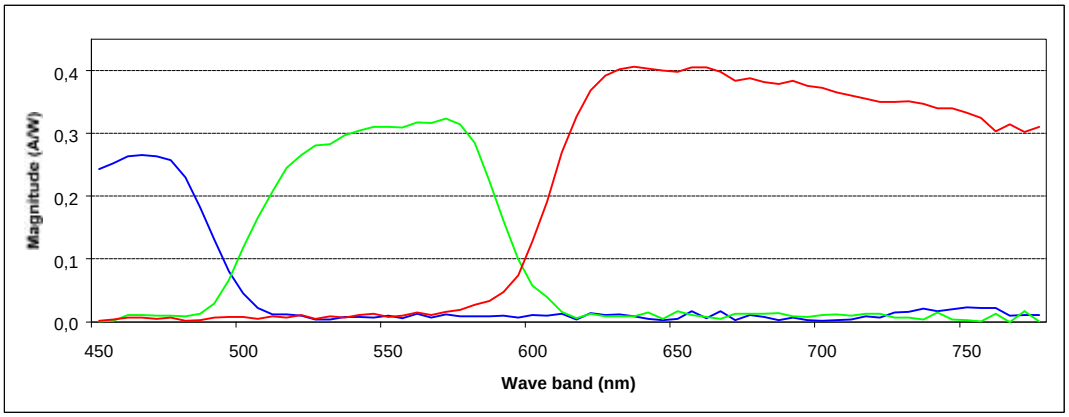
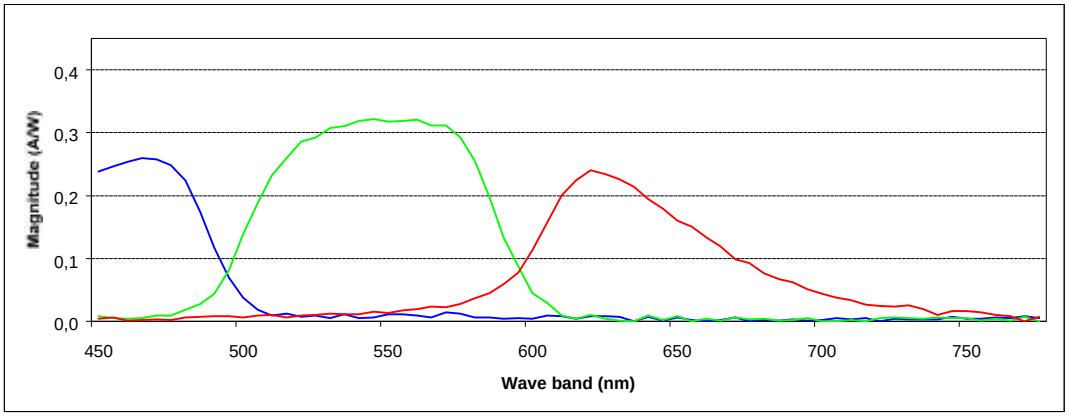
CHARACTERISTIC CURVE

1.1 Typical spectral sensitivity of the 3-element color sensor (MCS3AT, MCS3AS)



1.2 Typical spectral sensitivity of the 3-element color sensor withIR-blocking (MCS3BT)



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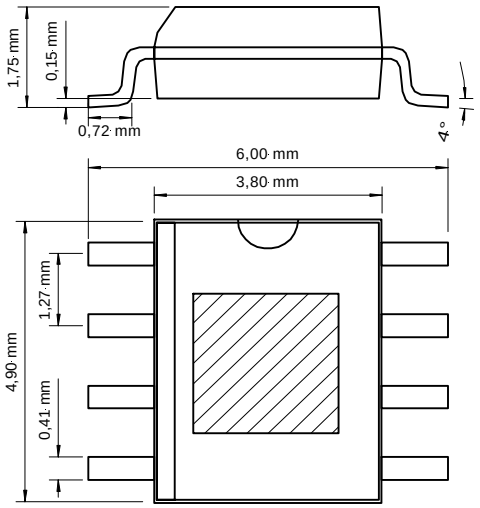
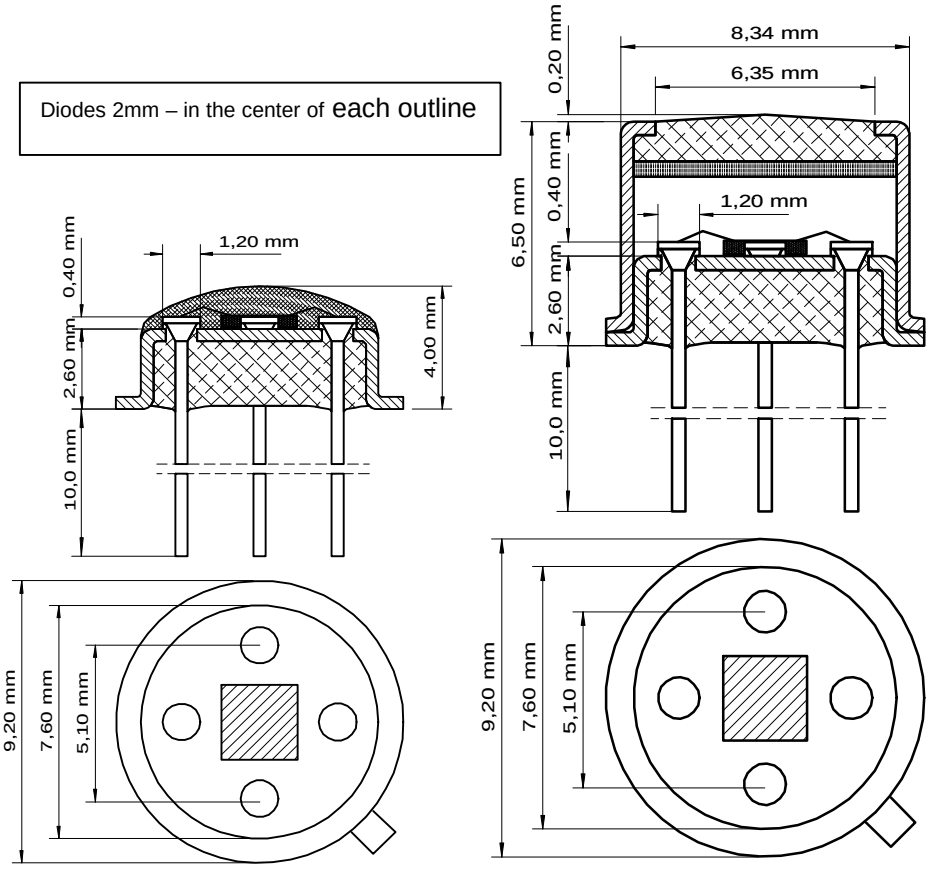
Package overview



SOP8 Package (MCS3AS)

Diodes 2mm – in the center of each outline



TO5 with transparent encapsulated plastic (MCS3AT) with optics[1] (MCS3AO) TO5 with windows cap (MCS3BT)	[1] working distance 50mm +/-5mm, angle of aperture stop +/-25

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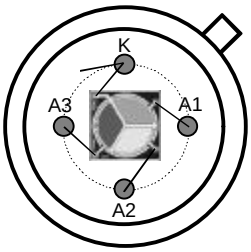
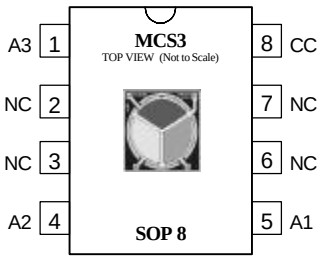
PIN-Configuration

(Top view)

PIN	description
1	A3 green
2	Nc
3	Nc
4	A2 blue
5	A1 red
6	nc
7	nc
8	common cathode



TO5-package

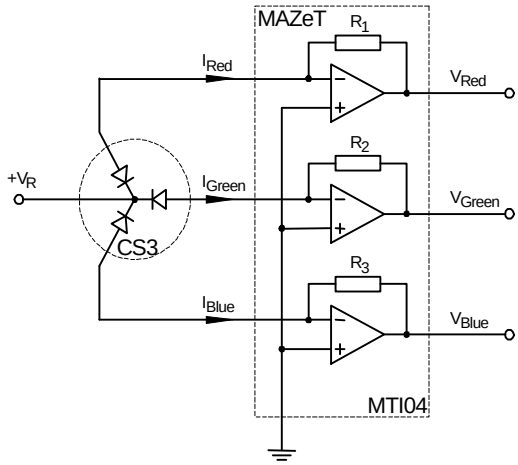


SOP8- package

Application circuit

Opposite figure shows a circuit for the conversion of photo current to an equivalent voltage. These voltage can be processed e.g. with an ADC. By the selection of suitable resistors the output voltage range can be adjusted to the photo current value.
(for example the pin-programmable transimpedance amplifier MTI04 with the resistors 25kΩ, 500kΩ and 5MΩ)

$$R_x \approx \frac{V_{Out}}{I_{Photo}}$$



Application note

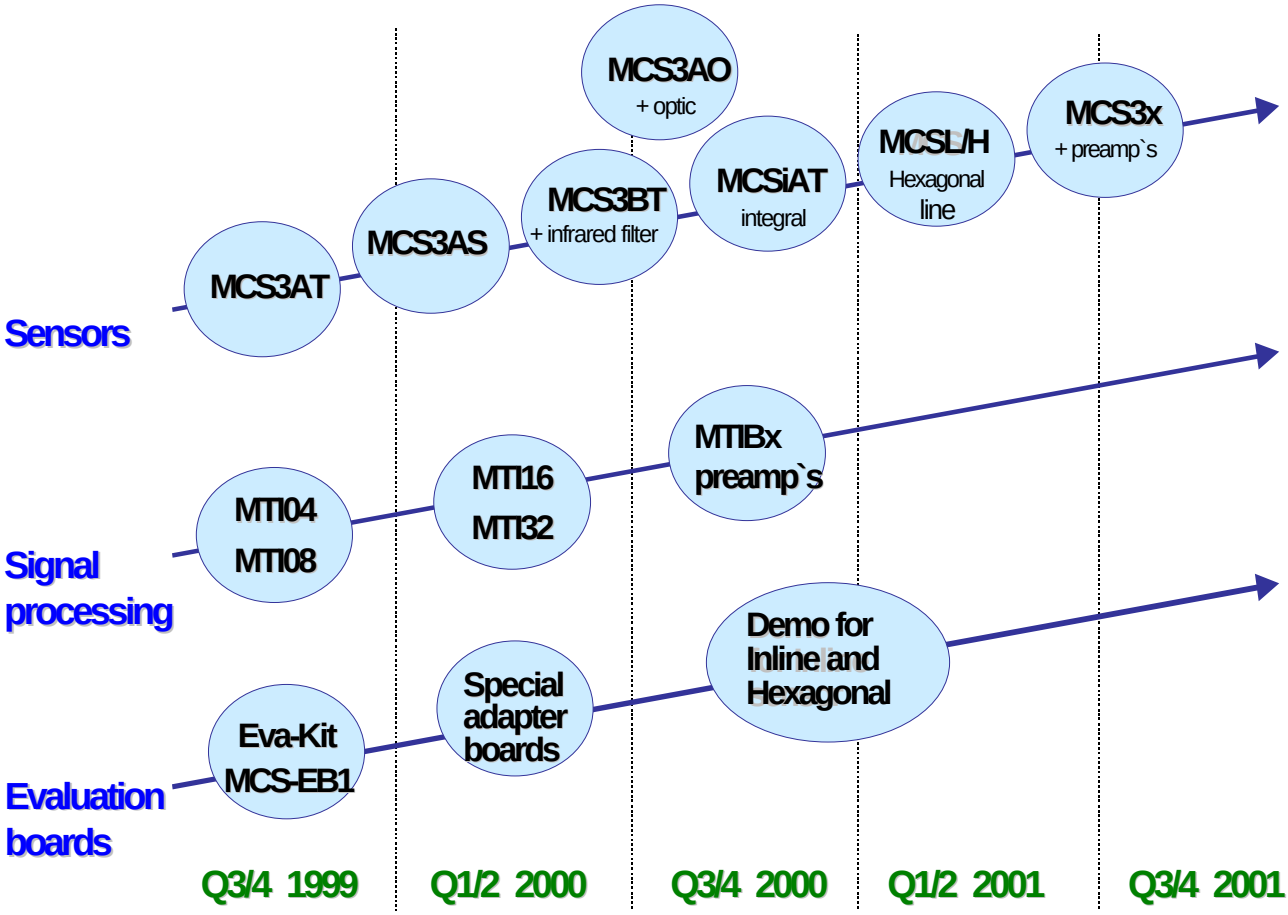
It is recommended to use an IR-block filter > 720nm or a light source with low infrared radiation for optimal operations of the color sensor.

The guard diode can be connected with the cathode or connected to ground.

Ordering information

Color sensor as Die	MCS3
Color sensor with TO5-package, transparent encapsulated (plastic)	MCS3AT
Color sensor with TO5-package, with top and IR-blocking windows	MCS3BT
Color sensor with SOP8-package, transparent encapsulated (plastic)	MCS3AS
Color sensor with SOP8-package, with optic	MCS3AO
Evaluation board for JENCOLOR sensors	MCS-EB1

Color Sensor Road Map and Overview



MCSiAT	Integral color sensor, Hexagonal matrix: 19 x 3 for 3 groups TO5, transparent encapsulated (plastic)
MCS3AO	+ optic, TO5 socket with optic cap
MCS3x	3-element color sensors, preamp's on chip
MCSLx	Line color sensor, 19 x 3 for groups, as MCM-BGA
MCSHx	Hexagonal color sensor, 19 x 3 for 3 groups, as MCM-BGA
Evaluation Boards	**DESCRIPTION**
MCS-EB1	Evaluation Board for 3-element color sensor with illumination equipment/PC connection
MCS-EB2	Evaluation Board for line and hexagonal color sensor with illumination equipment/PC connection
Transimpedance Amplifier	**DESCRIPTION**
MTI04	4-channel transimpedance amplifier
MT04AD	As Die, sawed on plastic wrap
MTI04AS	As SOP18
MTI08...MTI32	8/16/32 -channel transimpedance amplifier as Die or SOP
MTIBxxx	4...32-channel transimpedance amplifier + MUX, +ADC, as Chip On Board