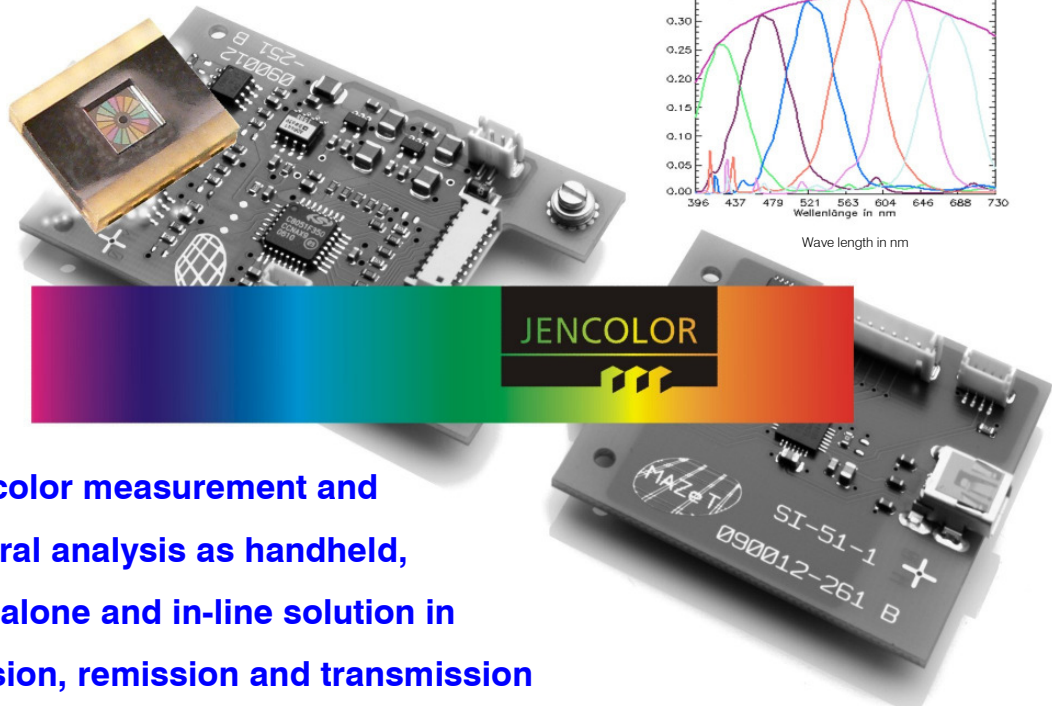


JENCOLOR

Multiple Color Sensor Solutions for Spectral Measurement

PRODUCT INFORMATION



Fast color measurement and spectral analysis as handheld, standalone and in-line solution in emission, remission and transmission

In applications that require very high color accuracy, three-element color sensors quickly reach its physical limitations, which are caused by limited light source availability and a relatively high error threshold. High-accuracy applications require spectral technologies that have a greater resolution than just three channels. A typical spectrometer would have the kind of resolution encountered in laboratory measurement devices, or in some OEM spectrometers for in-line measurements. Unfortunately, such spectrometers are too slow, too expensive and too big for most sensor applications.

With the Multiple Color Sensor, MAZeT is closing the gap between tri-color sensors and spectral analyzers. The new sensor employs compact, price-performance-optimized semiconductor sensors with integrated interference filters and combines these with seven spectral bands (ranging from 380 to 780 nm) to produce a fast and precise color measurement and/or single spectral analyses based on spectral approximation method's. In this sensor, the color is not analyzed on the colorimetric level but on the radiometric level.

The output from the sensor does not indicate the color space but the color's or wavelength spectrum, which is then used to compute the color space or alternative results like presences or concentrations bases on spectral characteristics. The advantage of this method is that a lot more information like color is produced.

With this sensor, metamerism effects are filtered out during capturing and analysis, which isn't possible with RGB and XYZ sensors. Metamerism effects are optically distinct spectrums that appear to be the same to the human eye when viewed in the same lighting conditions.

The spectral bands of the MMCS6 all overlap. As a result, there are virtually no gaps in the visible spectrum. This minimizes any erroneous color interpretation and increases the measurement accuracy. In typical usage scenarios, the sensor is not affected by the quality of the light source. The Sensor's spectral approximation of the measured colors can indicate color variations that are imperceptible to the human eye or refers to spectral interpretations for gas, materials and fluids.

Sensor Highlights

- Color measurement based on spectral evaluation and selective spectral analysis
- Spectral value output
- Calibration in Lab/Luv system
- High absolute accuracy
e.g. $\Delta E_{\text{mean}} < 0.5$; RAL classic;
LED white peak=450 nm & high repeat accuracy <0.5 %
- Signal frequency >100 kHz
- SMD chip, 7x6x1.7 mm
- no temperature and long-time shifts
- Applications, for example:
Color Measurement/Detection and Spectral Analyzes for biological, chemical, medical, fluorescence, automation, hand-held application

Preliminary
Product Information
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The table on the right compares three sensor types and their errors for measurement refers for a typical application. This demonstrates the different accuracy categories of color measurements using color sensors and white-light LEDs for RAL (Color Classics) detection. The measurement values were attained by illuminating a set of predefined color plates with a white-light LED (lpeak = 450 nm). The column of the table shows how the accuracy decreases significantly from the Multiple Color Sensor to the True Color sensor to the RGB sensor.

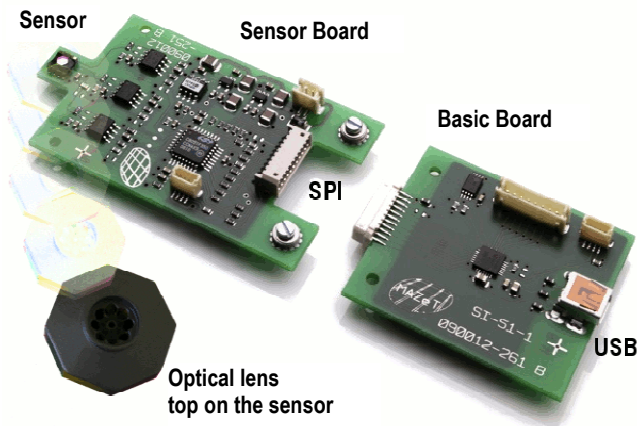
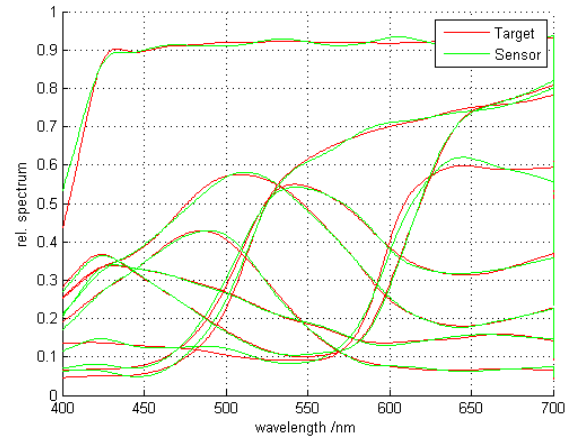
Under conditions like homogenously (wide band) light source and targets the results of the Multiple Color Sensor could be calculated to spectral curves. In the right figure a comparison of measured results between a spectrometer (red) and calculated sensor results (green) is shown. In this application and system the sensor achieves nearly the same results (spectral curves) for this probe like the spectrometer. That opens for the Multiple Color Sensor many new markets which were reserved for spectrometers until today.

MAZeT develops and supplies application-specific and customized OEM hardware and software solutions based on the Multiple Color Sensors.

Comparisons to alternative sensors

Sensor	Delta E ¹	
	max	mean
Multiple Color Sensor	1,27	0,16
True Color Sensor	2,77	0,5
RGB Sensor	10,69	1,72

Comparison: Sensor and Spectrometer



MAZeT is offering the new sensor as single Chip solution (TIAM4) and as part of customized OEM-solutions. It ships with an extensive software library for highly accurate and fast color / material measurement using hand-held or in-line devices. Before starting development the customer could simulate the application by MAZeTs JENCOLOR Simulator and / or use one of the Evaluation Kits. These test systems exists from an application specific sensor board (with different amplifiers - I/U or I/C converter), the basic board for PC connection, an optical head and a plug-module for LED illumination. Please ask our technical staff or sales team for an optimized test kit and/or pre-designed OEM PCB solution with integrated Multiple Color Sensors.

Component	Sensor board MMCS-SCAN-EB1	Sensor board MMCS-INT-EB1
Basic board	C8051F321 (8 bits, 25 MIPS), sensor interface: (I2C) or SPI, communication PC: via USB	
Test software	USB driver, monitor program incl. Excel report, support of various functions such as calibration, test	
Amplification principle	Transimpedance amplifier - Current-voltage conversion using the MAZeT MT108 discrete integration (summing)	Current-charge conversion using the TI DDC114, continuous integration ([Ion] = fA..µA)
AD conversion/µC	16 bit ADC in the µC / C8051F065 (8 bits, 25 MIPS)	20 bits in the amplifier / STM32F101xB (32 bits, 40 DMIPS)
Measurement frequency	approx. 10,000 ... 20,000 SPS	
Interface	Standard: SPI Sensor board; USB Basic Board Option: I2C, RS432, I/O, LED control	Standard: SPI Sensor board; USB Basic Board Option: I2C, RS432, I/O, LED control
Accessories	LED board, optical lens to maintain the measurement geometry 0° sensor / 45° LED illumination, Libraries	

You can obtain additional information from our website at www.JENCOLOR.de or from our sales offices!

¹ Values are typical for an application and depends on filter, light source, target and calibration method.