Agilent HDJD-S831-QT333 Color Sensor Module

Data Sheet

Features

- **Converts light to R,G,B voltage output**
- **Monolithic CMOS IC solution with integrated R,G,B color filter, photodiode array, trans-impedance amplifier in one chip**
- **12x12 photodiode array design minimizes the effect of contamination and optical aperture misalignment**
- **Spectral sensitivity response optimized for RGB-LED backlight application: good detection capability in light chromaticity drift**
- **Small module size (27.6 mm x 7 mm x 3 mm)**
- **Internal 5 V to 3.3 V voltage regulator**

Description

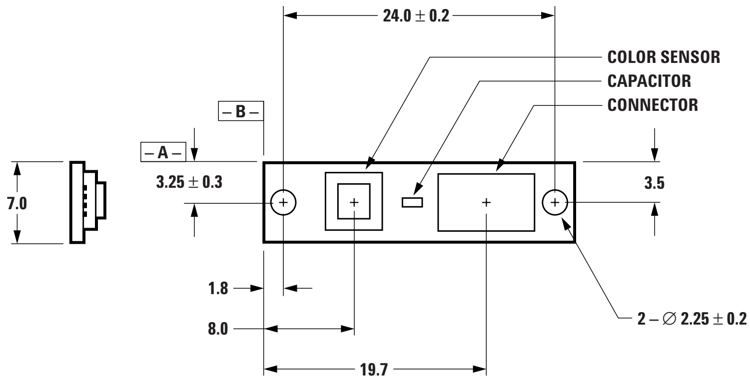
Agilent Color Sensor is a high performance, small in size, cost effective light to voltage converting sensor. The sensor combines a photodiode array and three trans-impedance amplifiers in a single monolithic CMOS IC solution. With Red (R), Green (G), and Blue (B) color filters coated over the photodiode array, the sensor converts RGB light to analog voltage outputs, denoted by VR_{OUT}, VG_{OUT} and VB_{OUT}, respectively. The sensor is driven by a single 5 V supply and incorporates an internal 5 V to 3.3 V voltage regulator. The color sensor module consists of a color sensor packaged in a 5 x 5 x 2 [mm] surface mount QFN-16, flat flexible cable connector and a decoupling capacitor mounted on a PCB.

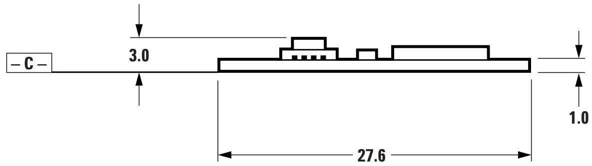
Applications

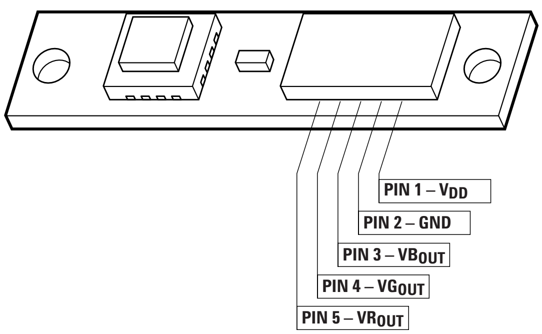
Agilent Color Sensor is ideal for open-loop color identification and closed-loop color point control. The spectral sensitivity response of the sensor is optimized for RGB-LED backlight applications. The sensor has good detection ability in light output chromaticity drift, when used with closed-loop feedback controller, manages to bring the backlight system to realize good du’v’ performance. Potential applications include white point control in emissive display, environmental lighting, color control in industrial processes, and many more.

Agilent Technologies

Package Dimensions



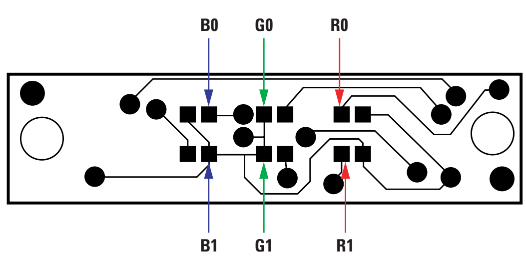




FLAT FLEXIBLE CABLE TO BE USED WITH THE CONNECTOR.

RECOMMENDED DIMENSIONS:
CABLE WIDTH: 3.0 ± 0.1 mm
CONDUCTOR PITCH: 0.5 ± 0.1 mm
INSERT THICKNESS: 0.3 ± 0.03 mm

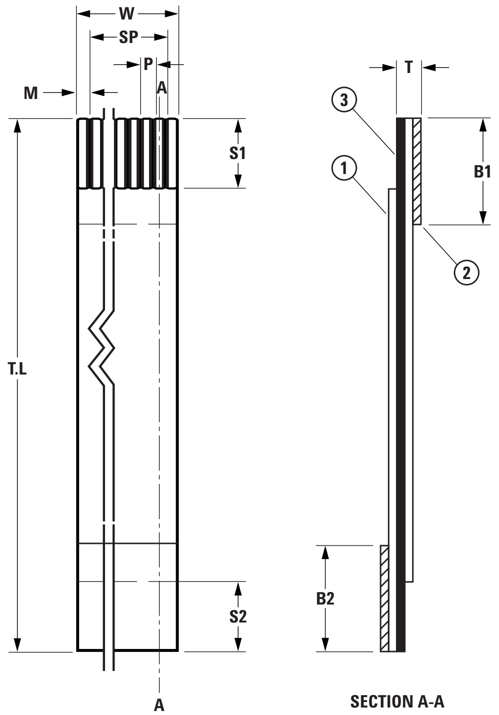
NOTE: DIMENSIONS ARE IN MILLIMETERS (mm)



NOTE:
BACK VIEW OF PCB

SHORT THE 2 PADS WITH JUMPER FOR 0; LEAVE THE 2 PADS OPEN FOR 1.
DEFAULT GAIN SELECTIONS ARE GS:11 FOR RED, GREEN AND BLUE.
REFER TO GAIN SELECTION FEEDBACK RESISTOR TABLE ON PAGE 8.

Recommended Flat Flexible Cable to be used with the Connector



NO.	ITEM NAME	SPECIFICATION	REMARK
1	INSULATION	20696(42 μ)	
2	P/TAPE	223 μ	

3	CONDUCTOR	THICKNESS	0.035	± 0.1
		WIDTH	0.32	± 0.03
		PLATED	TIN (1 μ)	MIN.

PITCH	P	0.5	± 0.1
SPAN	SP	2.0	± 0.1
WIDTH	W	3.0	± 0.1
MARGIN	M	0.5	± 0.1
INSERT THICKNESS	T	0.3	± 0.03
PROTECTOR LENGTH	B1	6.0	± 1.5
	B2	6.0	± 1.5
STRIP LENGTH	S1	4.0	± 1.0
	S2	4.0	± 1.0
TOTAL LENGTH	T.L	OPTIONAL	
NO. OF PIN		5P	

NOTE: DIMENSIONS ARE IN MILLIMETERS (mm)

Part Numbering System

HDJD-S 8 X X - X X X X X

Gain Selection (GS) Option

	Red	Green	Blue GS
333:	11	11	11

Packaging Type
T: Tray Standard Pack

Product Packaging
Q: QFN

Config ID/Filter Attachment
1: With IR Filter

Product Type
3: Module Level

Pin Out for HDJD-S831-QT333 Color Sensor Module

Pin Descriptions for Flat Flexible Cable Connector

Pin	Name	Description
1	VDD5	5 V DC Supply
2	GND	Ground
3	VB_{OUT}	Analog Output Voltage for Blue
4	VG_{OUT}	Analog Output Voltage for Green
5	VR_{OUT}	Analog Output Voltage for Red

Device Selection Guide

	Gain Selection[2]					
	Red		Green		Blue	
Part Number	**GS: Bit 1**	**Bit 0**	**GS: Bit 1**	**Bit 0**	**GS: Bit 1**	**Bit 0**
HDJD-S831-QT333[1]	1	1	1	1	1	1

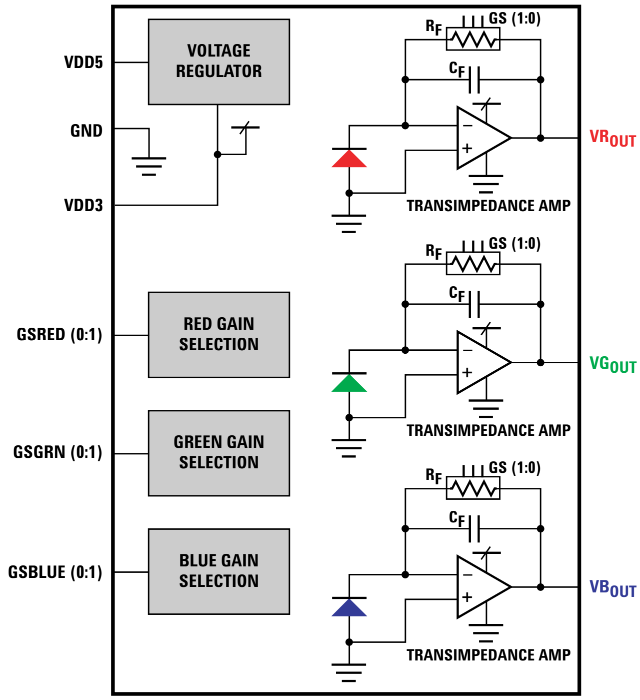
Note:

1. HDJD-S831-QT333 a is gain selections selectable. Please refer to gain Selection Feedback Resistor Table for different feedback resistor setting for different gain selections.
2. 0 indicates that the pin is connected to ground. 1 indicates no connection.

Theory of Operation

The integral R,G,B color filters on the photodiode array detect the R,G,B components of the light falling on the sensor. The photodiode converts the R,G,B light components into photocurrents. The integrated transimpedence amplifiers for R,G,B components then convert the photocurrent to analog voltage outputs. The voltage output of each R,G,B channel increases linearly with increasing light intensity.

Sensor IC Block Diagram



Absolute Maximum Ratings[1,2]

Parameter	Symbol	Min.	Max.	Unit	Notes
Supply Voltage	V_{DD5}	4.5	5.5	V	
Storage Temperature	T_S	-20	85	°C	
Operating Temperature	T_A	-20	85	°C	
Human Body Model ESD Rating	ESD_{HBM}		2	kV	Reference to JESD22-A114-B

Notes:

1. Subjecting the part to stresses beyond those listed under this section may cause permanent damage to the device. These are stress ratings only and do not imply that the devices will function beyond these ratings. Exposure to the extremes of these conditions for extended periods may affect device reliability.
2. Unless otherwise specified, voltages are referenced to ground.

Recommended Operating Conditions

Parameter	Symbol.	Min.	Typ.	Max.	Units
Operating Temperature	T_A	0	25	70	°C
Supply Voltage	V_{DD5}	4.5	5.0	5.5	V

Operating Conditions and Electrical Requirements

Electrical Characteristics at V_{DD} = 5 V, T_A = 25°C, R_L = 68 kΩ

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Dark Voltage	V_D	Ee = 0			15	mV
Maximum Output Voltage Swing	$V_{0\,MAX}$			3		V
Supply Current	I_{DD}	Ee = 0		3		mA
Output Rise Time	tr	Min Vo = 0 V, Peak Vo = 2.0 V			15	µs
Output Fall Time	tf	Min Vo = 0 V, Peak Vo = 2.0 V			15	µs
Irradiance Responsivity	Re	GS:00 λ_P = 460 nm[1] (Blue Channel)		3.10		V/(mW/cm²)
		GS:00 λ_P = 542 nm[2] (Green Channel)		3.90		
		GS:00 λ_P = 622 nm[3] (Red Channel)		1.10		
		GS:00 λ_P = 645 nm[4] (Red Channel)		0.85		
Irradiance Responsivity	Re	GS:11 λ_P = 460 nm[1] (Blue Channel)		1.55		V/(mW/cm²)
		GS:11 λ_P = 542 nm[2] (Green Channel)		1.95		
		GS:11 λ_P = 622 nm[3] (Red Channel)		0.55		
		GS:11 λ_P = 645 nm[4] (Red Channel)		0.43		
Irradiance Responsivity	Re	GS:01 λ_P = 460 nm[1] (Blue Channel)		0.78		V/(mW/cm²)
		GS:01 λ_P = 542 nm[2] (Green Channel)		0.98		
		GS:01 λ_P = 622 nm[3] (Red Channel)		0.28		
		GS:01 λ_P = 645 nm[4] (Red Channel)		0.21		
Irradiance Responsivity	Re	GS:10 λ_P = 460 nm[1] (Blue Channel)		0.41		V/(mW/cm²)
		GS:10 λ_P = 542 nm[2] (Green Channel)		0.52		
		GS:10 λ_P = 622 nm[3] (Red Channel)		0.15		
		GS:10 λ_P = 645 nm[4] (Red Channel)		0.11		

Operating Conditions and Electrical Requirements (cont'd.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Saturation Irradiance[5]		GS:00 λ_P = 460 nm[1] (Blue Channel)		1.0		mW/cm^2
		GS:00 λ_P = 542 nm[2] (Green Channel)		0.8		
		GS:00 λ_P = 622 nm[3] (Red Channel)		2.7		
		GS:00 λ_P = 645 nm[4] (Red Channel)		3.5		
Saturation Irradiance[5]		GS:11 λ_P = 460 nm[1] (Blue Channel)		1.9		mW/cm^2
		GS:11 λ_P = 542 nm[2] (Green Channel)		1.5		
		GS:11 λ_P = 622 nm[3] (Red Channel)		5.5		
		GS:11 λ_P = 645 nm[4] (Red Channel)		7.0		
Saturation Irradiance[5]		GS:01 λ_P = 460 nm[1] (Blue Channel)		3.9		mW/cm^2
		GS:01 λ_P = 542 nm[2] (Green Channel)		3.1		
		GS:01 λ_P = 622 nm[3] (Red Channel)		10.7		
		GS:01 λ_P = 645 nm[4] (Red Channel)		14.3		
Saturation Irradiance[5]		GS:10 λ_P = 460 nm[1] (Blue Channel)		7.3		mW/cm^2
		GS:10 λ_P = 542 nm[2] (Green Channel)		5.8		
		GS:10 λ_P = 622 nm[3] (Red Channel)		20.0		
		GS:10 λ_P = 645 nm[4] (Red Channel)		27.3		

Notes:

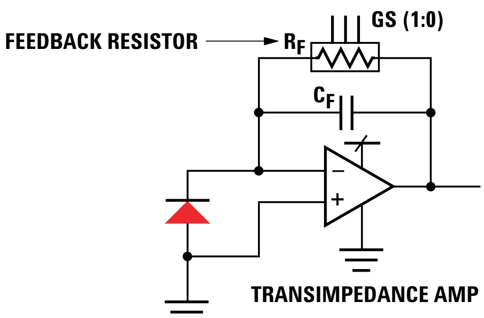
1. Test condition: using blue diffuse light of peak wavelength (λ_P) 460 nm and spectral half width ($\Delta\lambda^1/_2$) 20 nm as light source.
2. Test condition: using green diffuse light of peak wavelength (λ_P) 542 nm and spectral half width ($\Delta\lambda^1/_2$) 35 nm as light source.
3. Test condition: using red diffuse light of peak wavelength (λ_P) 622 nm and spectral half width ($\Delta\lambda^1/_2$) 20 nm as light source.
4. Test condition: using red diffuse light of peak wavelength (λ_P) 645 nm and spectral half width ($\Delta\lambda^1/_2$) 20 nm as light source.
5. Saturation irradiance = (max output voltage swing)/(irradiance responsivity).

Gain Selection Feedback Resistor Table

GSRED1	GSRED0	GSGRN1	GSGRN0	GSBLUE1	GSBLUE0	Feedback Resistor
0	0	0	0	0	0	3.0 MΩ
0	1	0	1	0	1	0.75 MΩ
1	0	1	0	1	0	0.4 MΩ
1	1	1	1	1	1	1.5 MΩ

Notes:

1. Gains selections, GS: Bit 1 Bit 0 are applicable for each Red, Green and Blue Channel.
2. Gain selections for each channel can be selected independently of each other.
3. Feedback resistor value is proportional to responsivity. Refer to block diagram below.
4. 0 indicates that the pin is connected to ground. 1 indicates no connection.



Typical Characteristics

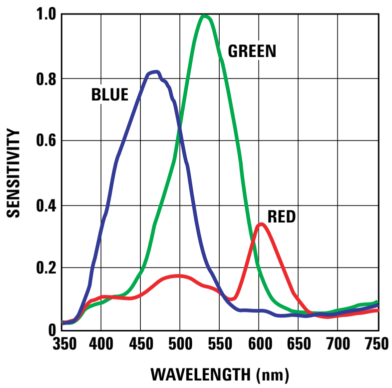


Figure 1. Spectral responsivity.

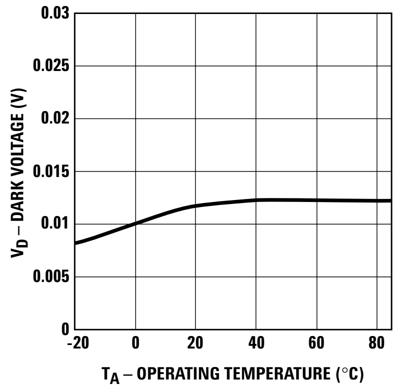


Figure 2. Dark voltage vs. operating temperature.

Note:

Test condition is when Gain Selection Jumpers are set to
GSBLUE1 = 0 GSGRN1 = 0 GSRED1 = 0
GSBLUE0 = 0 GSGRN0 = 0 GSRED0 = 0
in which 0 = connect to Ground, 1 = no connection.
Refer to Gain Selection Feedback Resistor Table.

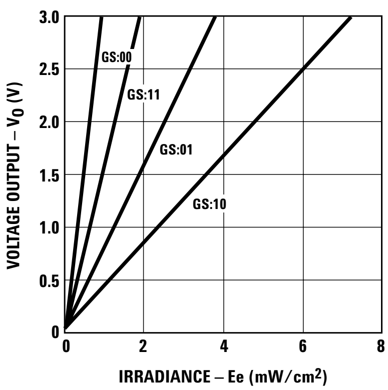


Figure 3. Voltage output of blue channel vs. irradiance (λp = 460 nm).

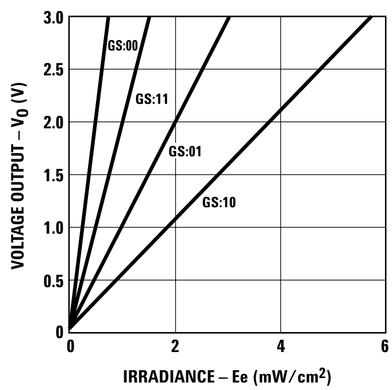


Figure 4. Voltage output of green channel vs. irradiance (λp = 542 nm).

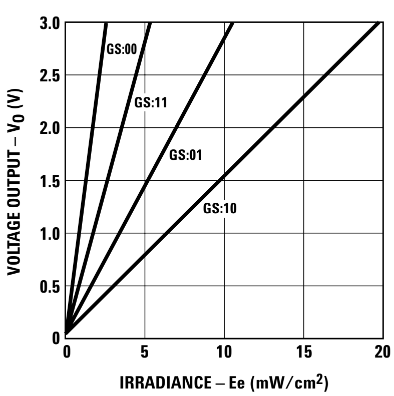
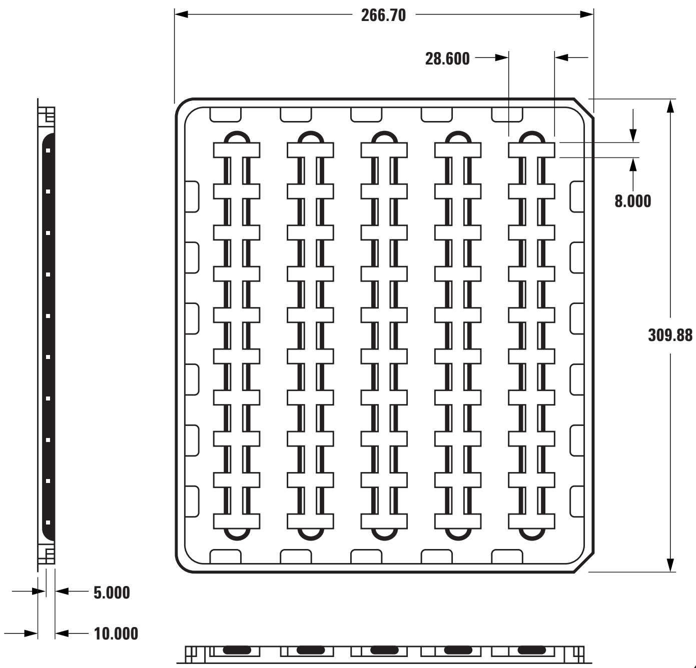
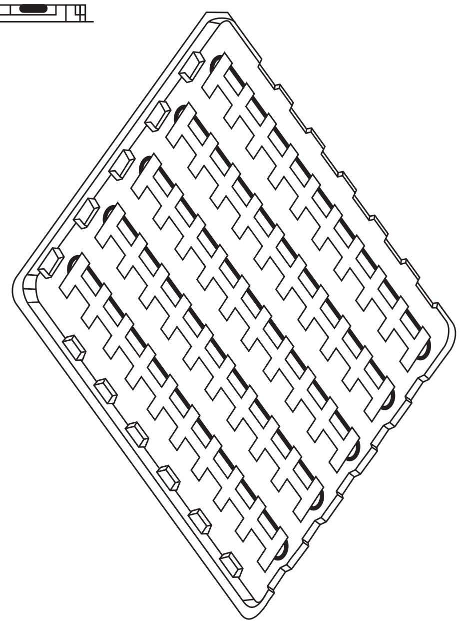


Figure 5. Voltage output of red channel vs. irradiance (λp = 622 nm).

Package Tray Standard Pack Dimensions





www.agilent.com/semiconductors

For product information and a complete list of distributors, please go to our web site.

For technical assistance call:

Americas/Canada: +1 (800) 235-0312 or (916) 788-6763

Europe: +49 (0) 6441 92460

China: 10800 650 0017

Hong Kong: (+65) 6756 2394

India, Australia, New Zealand: (+65) 6755 1939

Japan: (+81 3) 3335-8152(Domestic/International), or 0120-61-1280(Domestic Only)

Korea: (+65) 6755 1989

Singapore, Malaysia, Vietnam, Thailand, Philippines, Indonesia: (+65) 6755 2044

Taiwan: (+65) 6755 1843

Data subject to change.

December 22, 2004

5989-2180EN

Agilent Technologies