Agilent HDJD-S722-QR999 Color Sensor

Data Sheet

Features

- **Convert 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**
- **3 sets of 3x3 photodiode array design minimize the effect of contamination and optical aperture misalignment**
- **Small in size 5x 5x1 mm**
- **Independent gain selection options for each R, G, B channel**

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 a Red (R), Green (G) and Blue (B) color filters coated over the photodiode array, the sensor converts R, G, B light to analog voltage outputs, denoted by VR_{OUT}, VG_{OUT} and VB_{OUT}, respectively. The sensor is packaged in a 5x5x1 (mm) surface mount QFN-16 package.

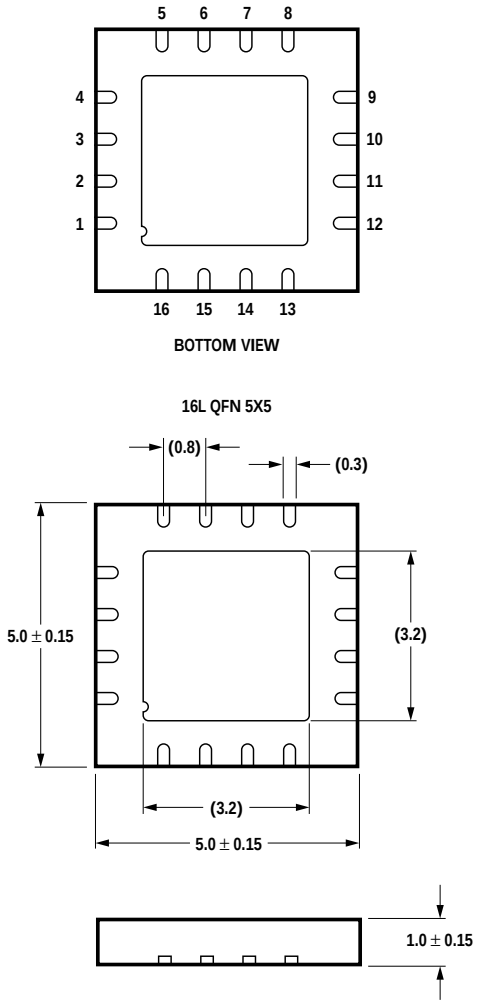
Applications

Agilent color sensor is ideal for open-loop color identification and closed-loop color point control. The sensor is designed for low illuminance applications including color detection, environmental lighting, industrial process, etc. With R, G, B photo-sensor and amplifier integrated in a single 5x5x1 (mm) package, Agilent color sensor provides a high performance, small in size and cost effective solution to color sensing.

ESD WARNING: *Standard CMOS handling precautions should be observed to avoid static discharge.*

Agilent Technologies

Package Dimension

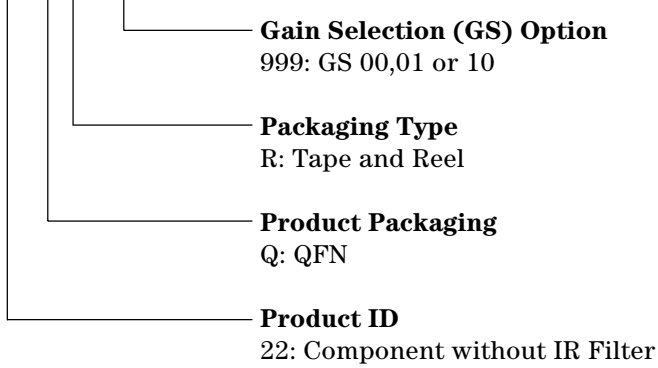


NOTE: DIMENSIONS ARE IN MILLIMETERS (mm)

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Part Numbering System

HDJD-S 7 X X-X X X X X



Pin Out for HDJD-S722-QR999

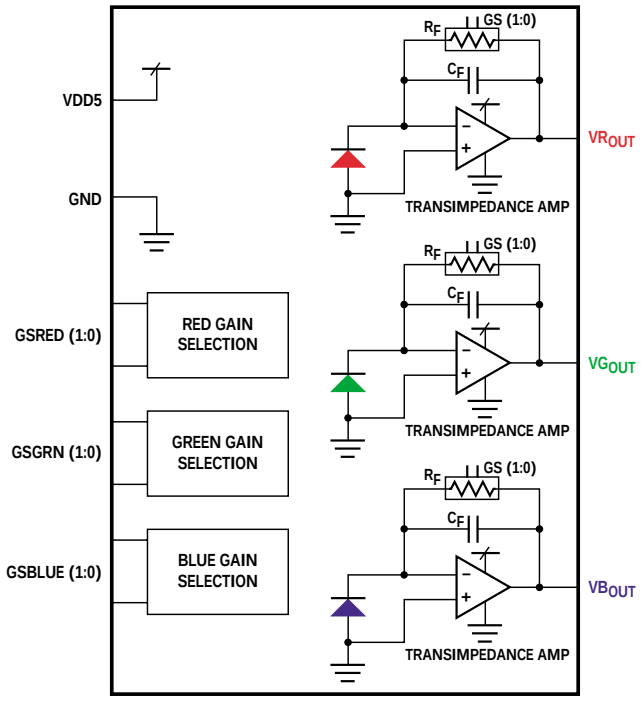
Pin	Pin Name	Normal Operation
Pin 1	VB_{OUT}	Analog output voltage for BLUE
Pin 2	VG_{OUT}	Analog output voltage for GREEN
Pin 3	VR_{OUT}	Analog output voltage for RED
Pin 4	VDD	5 V DC Supply
Pin 5	GND	Ground
Pin 6	GSGRN1	Gain Selection Green bit 1
Pin 7	GND	Ground
Pin 8	GSRED1	Gain Selection Red bit 1
Pin 9	GSRED0	Gain Selection Red bit 0
Pin 10	NC	No connection
Pin 11	NC	No connection
Pin 12	GSBLUE0	Gain Selection Blue bit 0
Pin 13	GSBLUE1	Gain Selection Blue bit 1
Pin 14	GND	Ground
Pin 15	GSGRN0	Gain Selection Green bit 0
Pin 16	GND	Ground

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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_{DD}	4.5	5.5	V	
Storage Temperature	T_S	-40	100	°C	
Operating Temperature	T_A	-40	85	°C	
Human Body Model ESD Rating	ESD_{HBM}		1	kV	

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	Notes
Operating Temperature	T_A	0	25	70	°C	
Supply Voltage	V_{DD}	4.5	5.0	5.5	V	A decoupling capacitor of 100 nF between V_{DD} and ground is recommended.

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Operating Conditions and Electrical Requirements

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

Parameter	Symbol	Remark	Min.	Typ.	Max.	Unit
Dark Voltage	V_D	Ee = 0			15	mV
Max. Output Voltage Swing	V_{OMAX}			4.8		V
Supply Current	I_{DD}	Ee = 0		2.5		mA
Output Rise Time	tr	Min Vo = 0 V, Peak Vo = 4.3 V		5		µs
Output Fall Time	tf	Min Vo = 0 V, Peak Vo = 4.3 V		5		µs
Irradiance Responsivity	Re	GS:10, λ_P = 460 nm[1] (Blue Channel)		15		V/(mW/cm²)
		GS:10, λ_P = 542 nm[2] (Green Channel)		19		
		GS:10, λ_P = 645 nm[3] (Red Channel)		27		
Irradiance Responsivity	Re	GS:01, λ_P = 460 nm[1] (Blue Channel)		9		V/(mW/cm²)
		GS:01, λ_P = 542 nm[2] (Green Channel)		11		
		GS:01, λ_P = 645 nm[3] (Red Channel)		16		
Irradiance Responsivity	Re	GS:00, λ_P = 460 nm[1] (Blue Channel)		5		V/(mW/cm²)
		GS:00, λ_P = 542 nm[2] (Green Channel)		6		
		GS:00, λ_P = 645 nm[3] (Red Channel)		9		
Saturation Irradiance[4]		GS:10, λ_P = 460 nm[1] (Blue Channel)		0.32		mW/cm²
		GS:10, λ_P = 542 nm[2] (Green Channel)		0.25		
		GS:10, λ_P = 645 nm[3] (Red Channel)		0.18		
Saturation Irradiance[4]		GS:01, λ_P = 460 nm[1] (Blue Channel)		0.53		mW/cm²
		GS:01, λ_P = 542 nm[2] (Green Channel)		0.44		
		GS:01, λ_P = 645 nm[3] (Red Channel)		0.30		
Saturation Irradiance[4]		GS:00, λ_P = 460 nm[1] (Blue Channel)		0.96		mW/cm²
		GS:00, λ_P = 542 nm[2] (Green Channel)		0.80		
		GS:00, λ_P = 645 nm[3] (Red Channel)		0.53		

Notes:

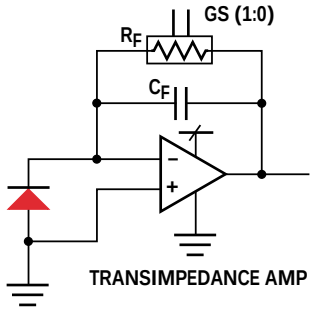
1. Test condition: using blue diffuse light of peak wavelength (λ_P) 460 nm and spectral half width ($\Delta\lambda^1/_2$) 25 nm as light source.
2. Test condition: using green diffuse light of peak wavelength (λ_P) 542 nm and spectral half width ($\Delta\lambda^1/_2$) 35 nm as light source.
3. Test condition: using red diffuse light of peak wavelength (λ_P) 645 nm and spectral half width ($\Delta\lambda^1/_2$) 20 nm as light source.
4. Saturation irradiance = (Max. output voltage swing)/(Irradiance responsivity).

***ESD WARNING:** Standard CMOS handling precautions should be observed to avoid static discharge.*

Gain Selection Feedback Resistor Table

GS: Bit 1	Bit 0	Feedback Resistor, R_F
0	0	4 MΩ
0	1	7 MΩ
1	0	12 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

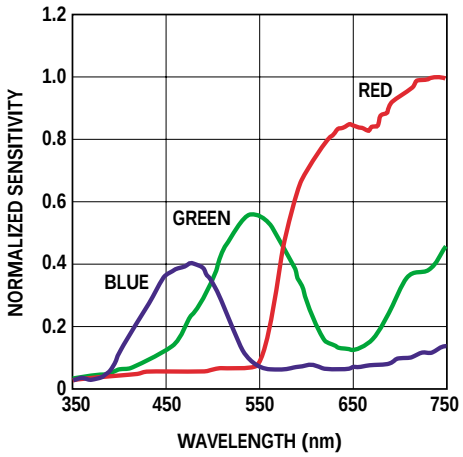


Figure 1. Spectral responsivity.

Note:
Test condition is when Gain Selection Jumpers are set to

GSBLUE1=0	GSGRN1=0	GSRED1=0
GSBLUE0=1	GSGRN0=1	GSRED0=1

in which 0 = connect to Ground, 1 = no connection. Refer to Gain Selection Feedback Resistor Table.

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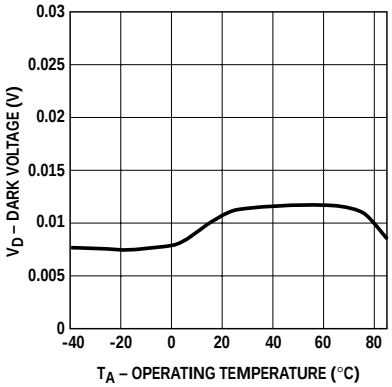


Figure 2. Dark voltage vs. operating temperature.

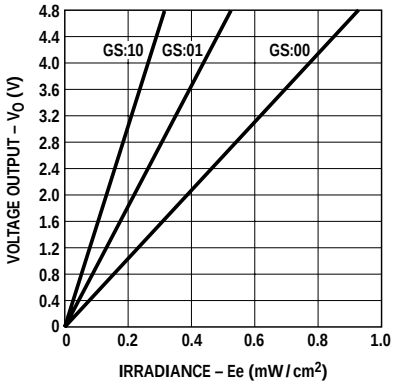


Figure 3. Voltage output of Blue Channel vs. irradiance (λp = 460 nm).

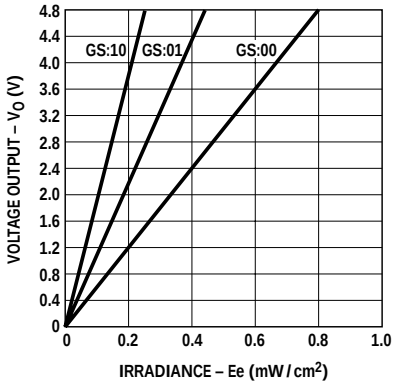


Figure 4. Voltage output of Green Channel vs. irradiance (λp = 542 nm).

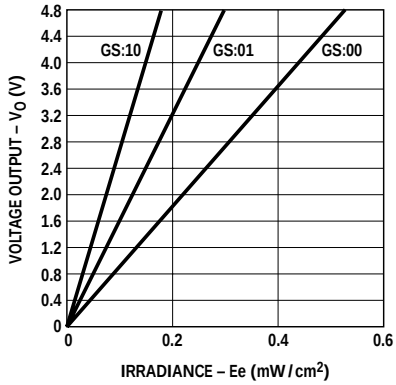


Figure 5. Voltage output of Red Channel vs. irradiance (λp = 645 nm).

ESD WARNING: *Standard CMOS handling precautions should be observed to avoid static discharge.*

Recommended Reflow Profile

It is recommended that Henkel Pb- free solder paste LF310 be used for soldering HDJD-S722-QR999. Below is the recommended reflow profile.

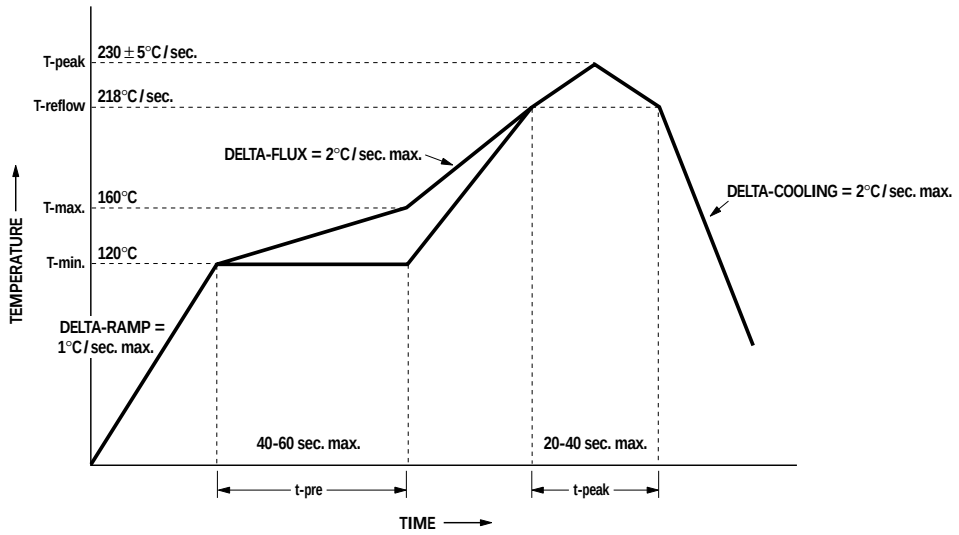


Figure 6. Recommended reflow soldering profile.

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16 Lead QFN Recommended PCB Land Pad Design

IPC-SM-782 is used as the standard for the PCB land-pad design. Recommended PCB finishing is OSP.

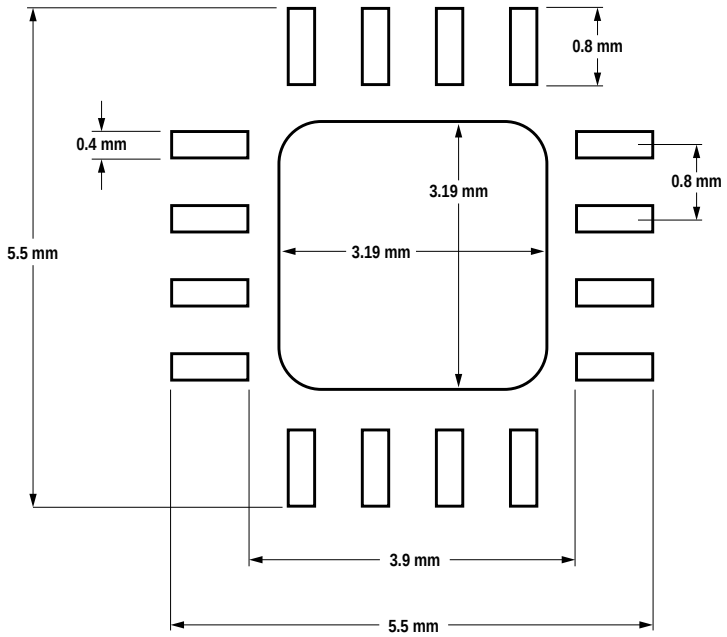


Figure 7.

16 Lead QFN Recommended Stencil Design

A stencil thickness of 2.18 mm (6 mils) for this QFN package is recommended.

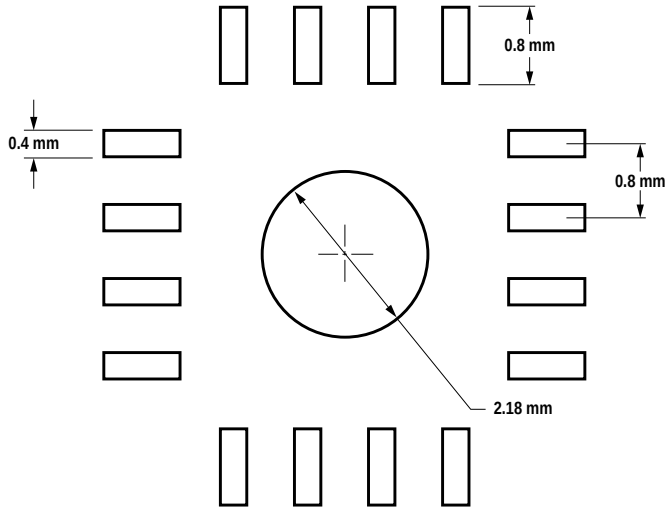


Figure 8.

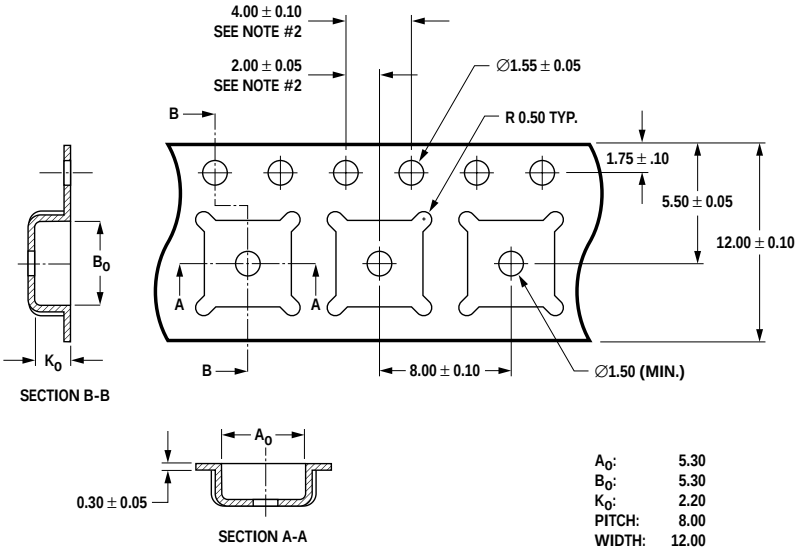
Recommendations for Handling and Storage of HDJD-S722-QR999

- **Before opening the MBB (Moisture Barrier Bag)**
  - The sensor component must be kept sealed in a MBB (Moisture Barrier Bag) stored at 30° C and 70% RH or less at all times.
- **After opening the MBB (Moisture Barrier Bag)**
  - The sensor component must be kept at 30° C and 60% RH or less.
  - The sensor component should have a MET (Manufacturing Exposure Time) of 24 hours starting from the time of removal from the MBB to the soldering oven.
  - If unused sensor components remain, it is recommended to store them back in the MBB.
  - If the indicator card has turned from blue to pink or it has exceeded the recommended MET (Manufacturing Exposure Time) of 24 hrs, baking treatment should be performed using the following conditions before continuing to IR reflow soldering.
  - Baking treatment: 24 hours at 125° C.

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Package Tape and Reel Dimensions

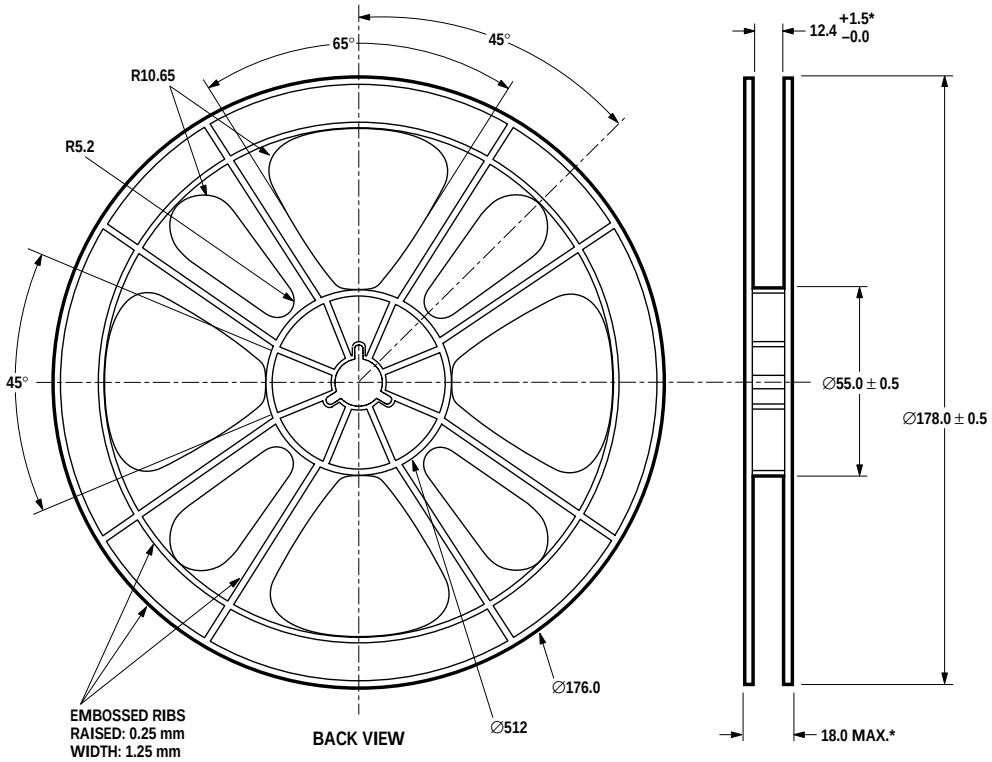
Carrier Tape Dimensions



A_0:	5.30
B_0:	5.30
K_0:	2.20
PITCH:	8.00
WIDTH:	12.00

NOTES:
1. A_0 AND B_0 MEASURED AT 0.3 mm ABOVE BASE OF POCKET.
2. 10 PITCHES CUMULATIVE TOLERANCE IS ± 0.2 mm.
3. DIMENSIONS ARE IN MILLIMETERS (mm).

Reel Dimensions



NOTES:
1. *MEASURED AT HUB AREA.
2. ALL FLANGE EDGES TO BE ROUNDED.

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